INSTALLATION RESTORATION PROGRAM
WORK PLAN

STAGE 2

AIR FORCE PLANT 85
COLUMBUS, OHIO

Battelle Columbus Division
505 King Avenue
Columbus, Ohio 43201

FEBRUARY 1989

FINAL (SEPTEMBER 1987-FEBRUARY 1989)

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PREPARED FOR

HEADQUARTERS AERONAUTICAL SYSTEMS DIVISION
FACILITIES MANAGEMENT DIVISION (ASD/PMDA)
WRIGHT-PATTERSON AIR FORCE BASE, OHIO 45435-6503

HEADQUARTERS AIR FORCE SYSTEMS COMMAND
COMMAND BIOENVIRONMENTAL ENGINEER
ANDREWS AIR FORCE BASE, DIST. OF COLUMBIA 20334-5000

UNITED STATES AIR FORCE
OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY
TECHNICAL SERVICES DIVISION (USAFOEHL/TS)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

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COMMAND BIOENVIRONMENTAL ENGINEER (AFSC/SGPB)
ANDREWS AIR FORCE BASE, DIST. OF COLUMBIA 20334-5000

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USAF CONTRACT NO. F33615-85-D4507, DELIVERY ORDER NO. 17

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USAFOEHL TECHNICAL PROGRAM MANAGER
CAROLYN K. BARLEY

USAF OCCUPATIONAL AND ENVIRONMENTAL HEALTH LABORATORY (USAFOEHL)
TECHNICAL SERVICES DIVISION (TS)
BROOKS AIR FORCE BASE, TEXAS 78235-5501

NOTICE

This report has been prepared for the United States Air Force by Battelle Columbus Division for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release prior to an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP, along with the evolving knowledge of site conditions and chemical effects on the environment and health, must be considered when evaluating this report, since subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the US Air Force adopts the conclusions, recommendations or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

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1.0 INTRODUCTION

1.1 AF IRP PROGRAM

The U.S. Air Force Installation Restoration Program (AF IRP) is a four-phased program designed for identification, confirmation/quantification, and remediation of problems caused by management of hazardous wastes at Air Force facilities. The phases are:

Phase I - Installation Assessment/Records Search
Phase II - Confirmation/Quantification
Phase III - Technology Base Development
Phase IV - Remedial Action

1.1.1 Program Origins

The United States Air Force (USAF), due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of disposal sites and take action to eliminate the hazards in an environmentally responsible manner.

The Department of Defense (DOD) developed the Installation Restoration Program (IRP) to ensure compliance with hazardous waste regulations. The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Headquarters Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the IRP. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous material contamination, and to control hazards to health and welfare that may have resulted from these past operations.

The identification of hazardous waste disposal sites at USAF installations was directed by DEQPPM 81-5 and implemented by Headquarters Air Force message dated 21 January 1982, as a positive action to ensure compliance of USAF installations with existing environmental regulations.

1.1.2 Program Objectives

The objective of the Air Force Installation Restoration Program is to assess past hazardous waste disposal and spill sites on USAF installations and develop remedial actions consistent with the National Contingency Plan (NCP) for those sites which pose a threat to human health and welfare or the environment. The intent is to conduct the remedial investigation and feasibility study in parallel, where feasible, instead of in serial fashion.

1.1.3 Program Organization

The U.S. Air Force Installation Restoration Program is a four-phased program designed for identification, confirmation/quantification, and remediation of problems caused by management of hazardous wastes at USAF facilities. Each phase is briefly described below.

- Phase I - Installation Assessment/Records Search - Identify past disposal sites that may pose a hazard to public health or the environment. Determine sites requiring further action, such as confirming an environmental hazard (Phase II) or, if a site requires immediate remedial action, proceed directly to Phase IV (remedial actions).

- Phase II - Confirmation/Quantification - Define and quantify the extent of contamination, waste characteristics (when required by the regulatory agency), and sites or locations where remedial actions are required. Phase II is an initial assessment of contamination to determine if contamination is present at a site. Sites found to be contaminated may require further investigation to assess the extent of contamination. Sites warranting immediate remedial action can be transferred to Phase IV. Otherwise, research requirements identified during Phase II will be included in the Phase III effort of the program.

- Phase III - Technology Base Development - Develop new technologies for treating pollutants that have no currently available or economically feasible treatment methodologies. This phase includes implementation of research requirements and technology development. A Phase III requirement can be identified at any time during the program.

- Phase IV - Remedial Actions - Preparation and implementation of the remedial action plan.

The IRP is the basis for assessment and response actions on USAF installations under the provision of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, by Executive Order 12316 and provisions of Subpart F of 40 CFR 300 (National Contingency Plan). CERCLA is the primary Federal legislation governing remedial actions at uncontrolled hazardous waste sites.

1.1.4 Program Documents

1.1.4.1 Work Plan

This work plan for the IRP Phase II Stage 2 (IRP Stage 2) effort has been prepared based on the findings and recommendations from the IRP Phase II Stage 1 investigation at Air Force Plant 85, Columbus, Ohio. The Work Plan details recommendations and decision rationale for conducting additional field work, performing a qualitative risk assessment, developing and screening potential remedial responses, and determining Applicable and Relevant or Appropriate Requirements (ARARs) and Data Quality Objectives (DQOs). The required format for the Work Plan is provided in the USAFOEHL "Handbook To Support The Integrated Installation Restoration Program (IRP), dated May 15, 1987. For sites where no additional work is recommended, draft documentation will be prepared for a Finding of No Significant Impact (FONSI).

1.1.4.2 Quality Assurance Project Plan (QAPP)

A QAPP for IRP Stage 2 has been prepared for AF Plant 85 that details field and laboratory quality assurance/quality control and methods protocols for performing the work specified in the Work Plan. The required format is provided in Section 5 of the USAFOEHL Handbook.

1.1.4.3 Health and Safety Plan (H&SP)

A Health and Safety Plan for IRP Stage 2 has been prepared to comply with USAF, OSHA, EPA, state, and local health and safety regulations regarding the work effort detailed in the Work Plan. The H&SP uses EPA guidelines for designating the appropriate level of protection needed at the study sites.

1.2 CURRENT STUDY OBJECTIVES

The current objectives of this study are to: 1) continue the investigations of the contaminated sites identified in the IRP Phase II Stage 1 studies on AF Plant 85; 2) determine the extent of, and obtain quantitative and qualitative data on concentrations of, contaminants in the vicinity of the various sites; 3) determine the rate, extent and direction of transport of contaminated surface water and groundwater onsite and the possible migration of these contaminants across the boundaries of AF Plant 85; 4) assess the possible risk to the environment and to human health that may result as a consequence of the contaminant migration; and 5) determine what remedial actions are required, and identify any feasible alternatives based on technology, environmental effectiveness, and cost.

2.0 BACKGROUND

2.1 BACKGROUND OF BASE ACTIVITIES

Construction of AF Plant 85 was begun in November 1940 and completed in December 1941 by the Defense Plant Corporation (PLANCOR). The plant produced naval aircraft during World War II under contract with the Curtiss-Wright Corporation. During World War II, the plant employed over 24,000 people and produced over 3,500 aircraft. Aircraft production declined substantially after the war, and Curtiss-Wright discontinued operation in 1950.

In November 1950, the U.S. Navy took title of the plant from the PLANCOR, and it became the Naval Industrial Reserve Aircraft Plant (NIRAP) Columbus. At that time, North American Aviation (now Rockwell International) began operations at the plant and was involved in the design, testing, and construction of numerous types of naval and aircraft and missile systems. Aircraft production declined substantially during the 1970s, so that by 1979, less than 2,000 employees remained at the plant.

In 1982, production of the B-1B Bomber aircraft commenced at Rockwell International. NIRAP Columbus was transferred from the jurisdiction of the Navy to the Air Force in 1982, and was redesignated AF Plant 85. The plant produces components for the B1-B, as well as components for the MX-Peacekeeper Missile and the space shuttle.

2.1.1 Description of Installation

AF Plant 85 is located in Franklin County, Ohio, in the eastern portion of the City of Columbus, about 5 miles east-northeast of downtown Columbus. Nearby incorporated towns include Whitehall (adjacent to the installation to the south), Bexley (about one mile to the southwest), and Gahanna (about one mile to the north). A vicinity map of AF Plant 85 is shown in Figure 2.1-1, and a site map of the installation is shown in Figure 2.1-2.

The total land area included in AF Plant 85 is approximately 518 acres. The main industrial plant facilities are located on approximately 288 acres alongside 5th Avenue, south of the Port Columbus International Airport. About 118 acres of the main plant area, including the areas of Building No. 3

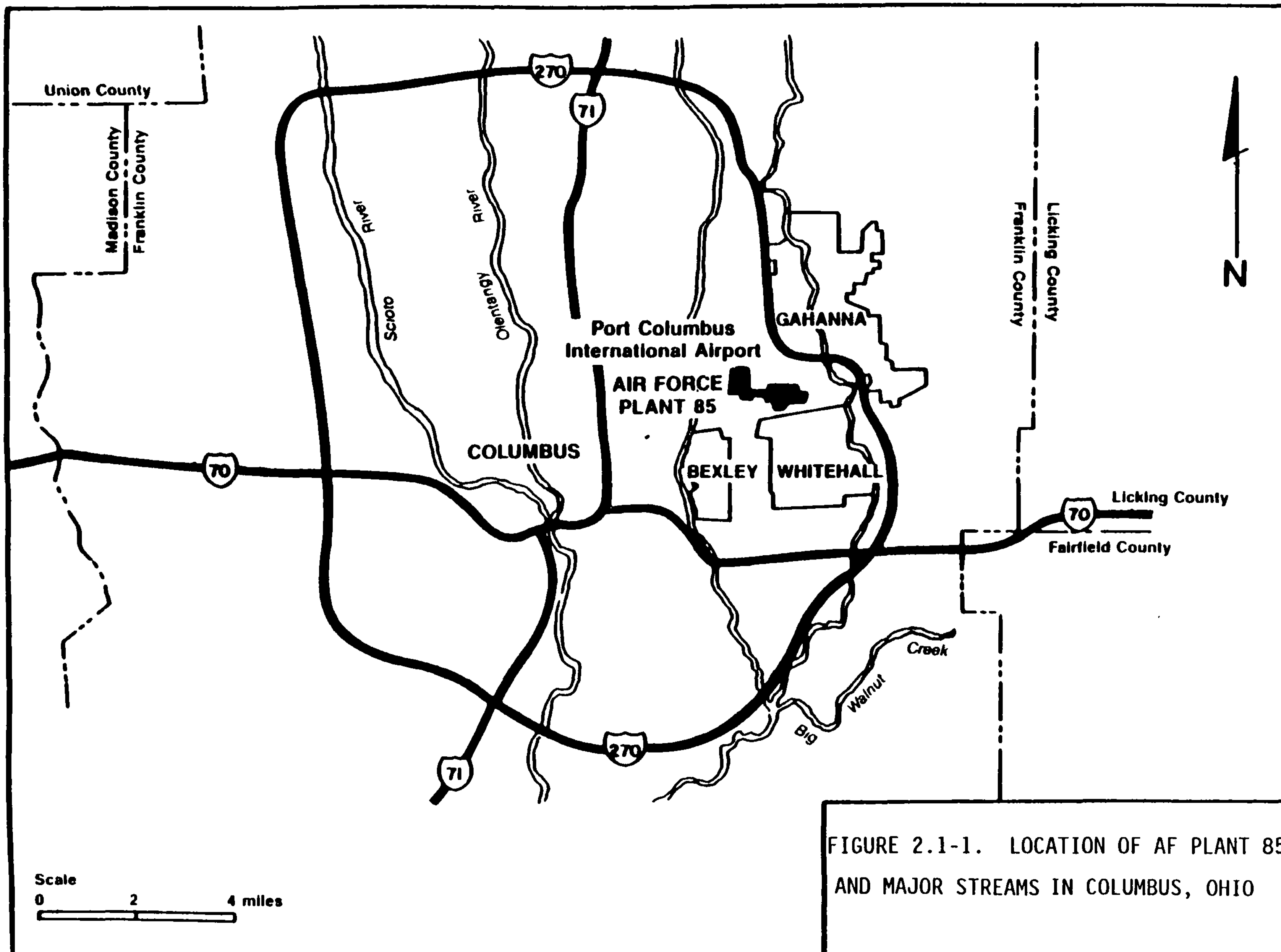


FIGURE 2.1-1. LOCATION OF AF PLANT 85 AND MAJOR STREAMS IN COLUMBUS, OHIO

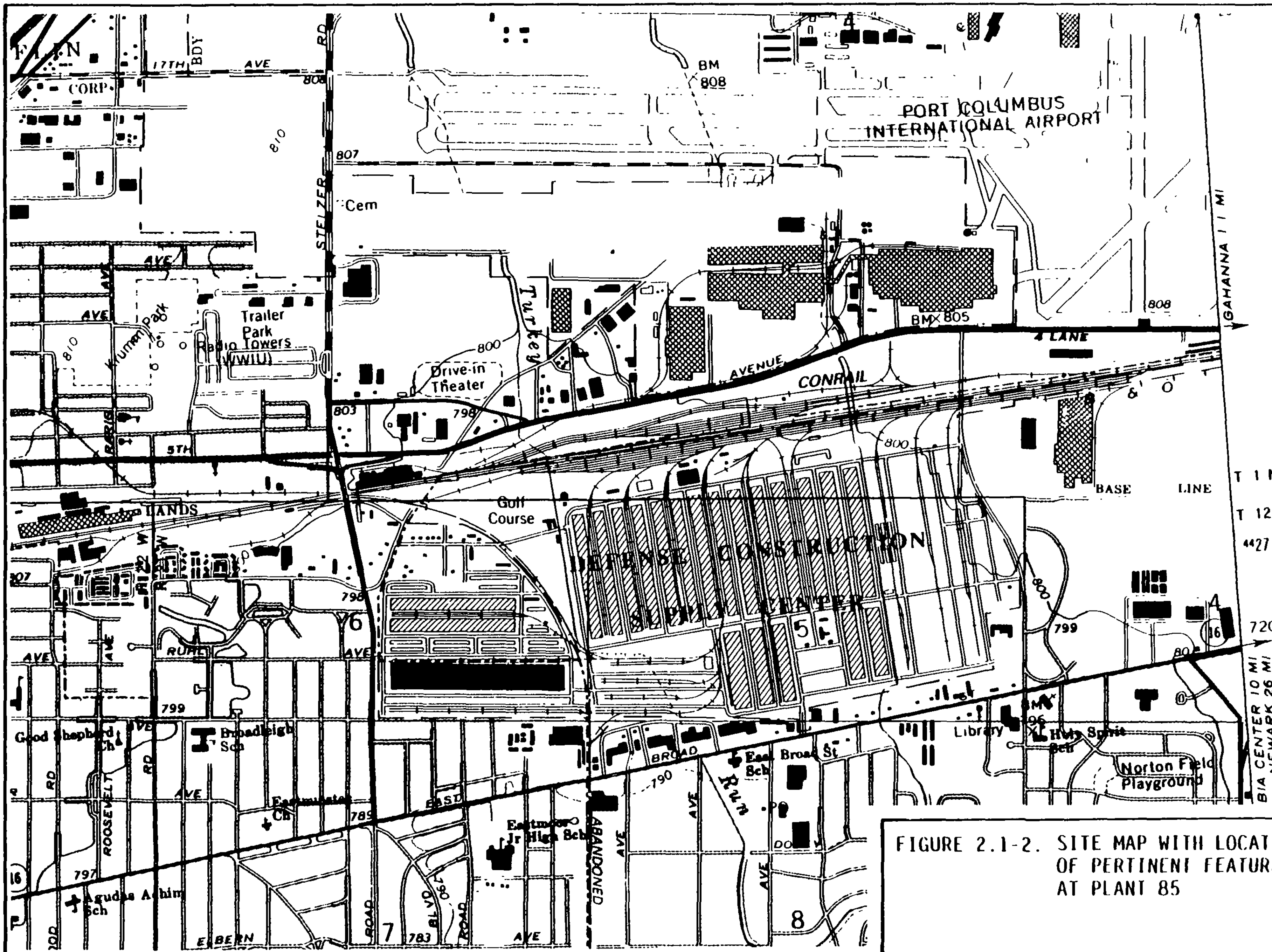


FIGURE 2.1-2. SITE MAP WITH LOCATIONS OF PERTINENT FEATURES, AT PLANT 85

and the North Ramp, are leased from the City of Columbus. Approximately 55 acres of land west of the main plant area were used as part of a former radar test range. The remaining 174 acres of AF Plant 85 are located west of Stelzer Road and contain the Instrument Landing System (ILS) operated by the Federal Aviation Administration (FAA).

2.1.2 Past Waste Management Practices

AF Plant 85 has been predominantly involved with the final assembly, and flight acceptance and testing, of newly constructed aircraft. The major industrial operations include machining and forming, metal finishing and electroplating, painting and coating, small parts assembly, and aircraft and missile subassembly.

The total quantities of paint sludges, waste oil, spent solvents, spent dip tank solutions, stripper, and cleaners currently generated at the plant range from 220,000 to 230,000 gallons annually. Of this total quantity, approximately 90,000 gallons consist of milling coolant oil and 73,000 gallons of paint sludges. The current rate of waste quantity generation is less than that of previous years when plant operations were larger. The types of wastes currently being produced are also different. The primary reasons for the different types and quantities of waste generation are provided below.

- Peak levels of production activity at AF Plant 85 occurred during World War II (1941-1945) and from the start of the Korean conflict (1951) through 1967. During these periods, waste production of solvents, contaminated fuels, and oils has been estimated at 30,000 to 40,000 gallons per year more than the current rate of waste production.
- Flightline operations were ended at the plant in 1981. Several laboratories associated with the testing of flightline aircraft (fuels lab, thermo lab, structures lab) were deactivated. In addition, the use (and, consequently, waste production) of jet fuels and engine oils was stopped at the facility.

The current level of waste generation is anticipated by plant personnel to remain relatively constant, or possibly increase slightly, over the next several years.

Past and present hazardous waste disposal practices at AF Plant 85 are presented in Table 2.1-1.

2.2 SITE-SPECIFIC BACKGROUND INFORMATION

During the latter half of 1983, CH2M-Hill conducted the IRP Hazardous Materials Disposal Sites Record Search (Phase I) for AF Plant 85, during which areas showing significant potential environmental impact were identified. The Phase I IRP recommended four sites for environmental sampling: Coal Pile (Site 2), Fire Department Training Area (Site 4), Mason's Run Oil/Fuel Spill Site (Site 5), and James Road Hazardous Waste Storage Pad (Site 8).

In late 1984, USAFOEHL developed the Statement of Work (SOW) for the Phase II Stage 1 investigation based on the CH2M-Hill Record Search and comments from the Ohio and U.S. Environmental Protection Agencies (EPAs). The purpose of the IRP Phase II Stage 1 investigation at AF Plant 85 was to confirm the existence or absence of hazardous waste constituents at specific sites. The four sites showing significant potential for environmental impact were cited for additional investigation. A fifth site, where a PCB spill occurred, was added to the list during the October 1984 Phase II Presurvey meeting.

A brief background of the sites is presented in the following subsections. Table 2.2-1 provides a generalized summary of detailed assessment at the sites during Phase II Stage 1.

Coal Pile (Site 2)

The Coal Pile (Site 2) is illustrated in Figure 2.2-2. This site has been used for coal storage since 1941. Leachate containing sulfuric acid and trace metals periodically entered Mason's Run until 1979, when an underdrain system leading to a collection sump was installed. Leachate is now pumped from the sump to the industrial waste water treatment plant (WWTP), where it is neutralized and then discharged to the sanitary sewer.

One groundwater sampling well has been installed near the leachate collection sump. The 10-foot screen was set below the water table. The well was finished in such a manner that the well would not interfere with traffic around the collection system. A groundwater sample was collected from this

TABLE 2.1-1. HISTORICAL DISPOSAL PRACTICES OF INDUSTRIAL WASTES AT AF PLANT 85

Time Period	Substance	Disposal Practice
1941-50	Waste oils, fuels, solvents	Burned at Fire Dept. Training Area
	Paint strippers	Discharged in vicinity of Bldg. No. 3; discharged into stormwater drainage system leading to Mason's Run
1951-65	Waste oils, solvents, fuels	Majority underwent offsite disposal; some still burned at Fire Dept. Training Area
	Electroplating and metals processing wastes	
	- Concentrated acid solutions	Batch collected and neutralized in holding tank and discharged into sanitary sewer for further treatment by City of Columbus
	- Overflow process rinse water	Discharged into Columbus sanitary sewer
	- Process tank sludges	Drummed and disposed of offsite
1965 - present	Waste oils and fuels	Most taken offsite by outside contractor until 1977; some from flight line operations burned in Fire Dept. Training Area
	Metal processing wastes	
	- Chromium solutions	Transported to on-site WWTP; hexavalent chromium reduced to trivalent state; reduced chromium solutions discharged to sanitary sewer
	- Cyanide wastes	Transported to holding tank at on-site WWTP, then disposed of offsite by outside contractor

TABLE 2.1-1. HISTORICAL DISPOSAL PRACTICES OF INDUSTRIAL WASTES AT AF PLANT 85 (Continued)

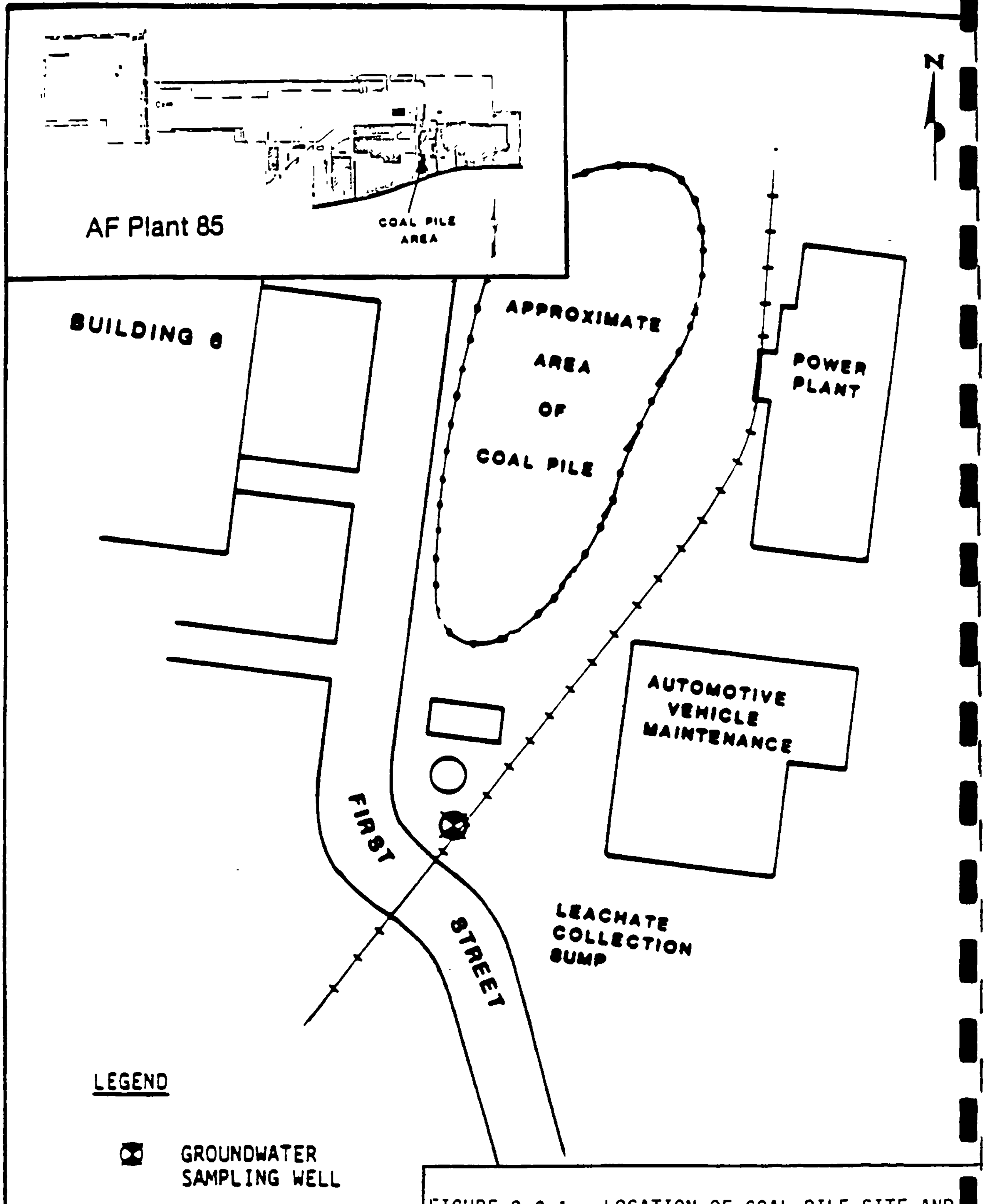
Time Period	Substance	Disposal Practice
1965 - present (Cont'd.)	- Process tank sludges	Collected, drummed, and then transported offsite by outside contractor
	Lime sludges (from WWTP)	Dewatered, collected in bulk containers and disposed of off-site by outside contractor
	Degreasing solvents	
	- TCA, Acetone, MEK	Collected in 55-gal. drums, stored at James Rd. Hazardous Waste Storage Pad, then sold to off-site recycling contractors
	- TCE	Stored in two underground tanks (Nos. 145 and 147) near the Oil House; used in fire dept. training or disposed of off-site by outside contractor
	Paint strippers	
	- Methylene chloride, phenolics	Collected in drip pans and held in 55 gal. drums, then disposed of offsite by outside contractor

TABLE 2.2-1 GENERALIZED SUMMARY OF EXPLORATORY AND SAMPLING ACTIVITIES CONDUCTED DURING PHASE II STAGE 1 AT AF PLANT 85

Site	Activity
Site 2, Coal Pile Leachate Site	Groundwater sampling - drilled to total depth of 45 feet and completed in Illinoisan outwash - 1 sample collected and analyzed for oil and grease, TOC, TOX, TDS, sulfate, arsenic, chromium, copper, lead, manganese, nickel, and zinc
Site 3, PCB Spill Site	Soil boring - 3 boreholes hand-augered - 3 samples per borehole collected and analyzed for PCBs
Site 4, Fire Department Training Area	Soil boring (3 locations) - each drilled to a total depth of 15 feet - 2.5-foot split-spoon sampling interval - 3 samples retrieved and analyzed per boring - each analyzed for oil and grease, purgeable organics, and total lead - sample from one borehole analyzed for EP Toxicity Groundwater sampling - 3 wells drilled in area, completed in Wisconsin Till - 10-foot screens set in each well, 8 feet below water table - water samples tested for TDS, pH, specific conductivity, TOX, TOC, purgeable organics, oil and grease, dissolved solids
Site 5, Mason's Run Creek	Stream bed sediment sampling (2 sets of 3 samples) - analyzed for grain/size, TDS, sulfate, TOC, purgeable organics Soil boring (2 locations: 1 north, 1 south) - one borehole to 45 feet; one to 53 feet - 2.5-foot split-spoon sampling interval - completed as sampling wells - entire saturated thickness screened in each well - analyzed for oil and grease, chromium, cadmium, lead and nickel

TABLE 2.2-1 GENERALIZED SUMMARY OF EXPLORATORY AND SAMPLING ACTIVITIES CONDUCTED DURING PHASE II STAGE 1 AT AF PLANT 85 (Continued)

Site	Activity
Site 5, Mason's Run Creek (Cont'd.)	Stream flow analysis - determined to obtain discrete surface water samples Surface water sampling (2 sets of 3 samples: 1 at site inflow point in north, 1 at site outflow point in south) - analyzed for oil and grease, TOC, TOX, purgeable organics, pH, specific conductance, temperature, sulfate, TDS, dissolved CR, Cd, Ni and Pb
Site 8, James Road Hazardous Waste Storage Pad	Groundwater sampling - 3 wells drilled and completed in Wisconsin Till - 10-foot screens set 8 feet below water table - 1 groundwater sample analyzed per well for pH, temperature, specific conductivity, TDS, TOC, TOX, purgeable organics, oil and grease Soil boring - 3 samples per borehole analyzed for purgeable organics and oil and grease Soil sampling from monitoring wells (3 soil samples per well - selected per OVA screening - analyzed for purgeable organics, oil and grease Drill cuttings - tested for EP toxicity (metals)



SOURCE: P.E.I. FINAL REPORT
U.S. AIR FORCE PLANT 85

FIGURE 2.2-1. LOCATION OF COAL PILE SITE AND GROUNDWATER SAMPLING WELL

well and analyzed for oil and grease, total organic carbon (TOC), total halogenated compounds (TOX), total dissolved solids (TDS), sulfate, and dissolved arsenic, chromium, copper, lead, manganese, nickel, and zinc.

PCB Spill Site (Site 3)

Transformer oil containing PCBs was spilled adjacent to Electric Substation 23 in January, 1983. The site was excavated twice, which produced an excavation 12 feet long by 5 feet wide by 9 inches deep. This trench was filled with clean dirt, and the contaminated soil taken from the excavation was removed from the site.

Three hand-augered borings have been taken (see Figure 2.2-1). Three samples taken from each boring have been analyzed for PCBs.

Fire Department Training Area (Site 4)

The Fire Department Training Area is depicted in Figure 2.2-3. For 36 years this site was used for the burning of fuel, solvents, waste oils, and waste magnesium chips. Until 1970, at least one training exercise per month was conducted. Each exercise consumed approximately 900 gallons of fuel. In 1977, the soil was excavated to a depth of 30 inches and the area was backfilled with clean soil. The soil left in place was not sampled or analyzed. The site is now a grassed field.

The general area of the burn pit has been determined by traversing the field during a visual inspection and by personal communication with Mr. F. Palumbo, a Rockwell employee. A soil-vapor survey has been performed for further identification of the burn pit.

Three soil borings have been placed in the burn pit area. The boreholes were extended to a depth of 15 feet and sampled continuously at 2.5-foot intervals. Based on the results of organic vapor analyzer (OVA) screenings, odor, and discoloration, three soil samples from each boring were analyzed for oil and grease, purgeable organics, and total lead. Upon completion, the borings were grouted with a bentonite/cement slurry. Cuttings

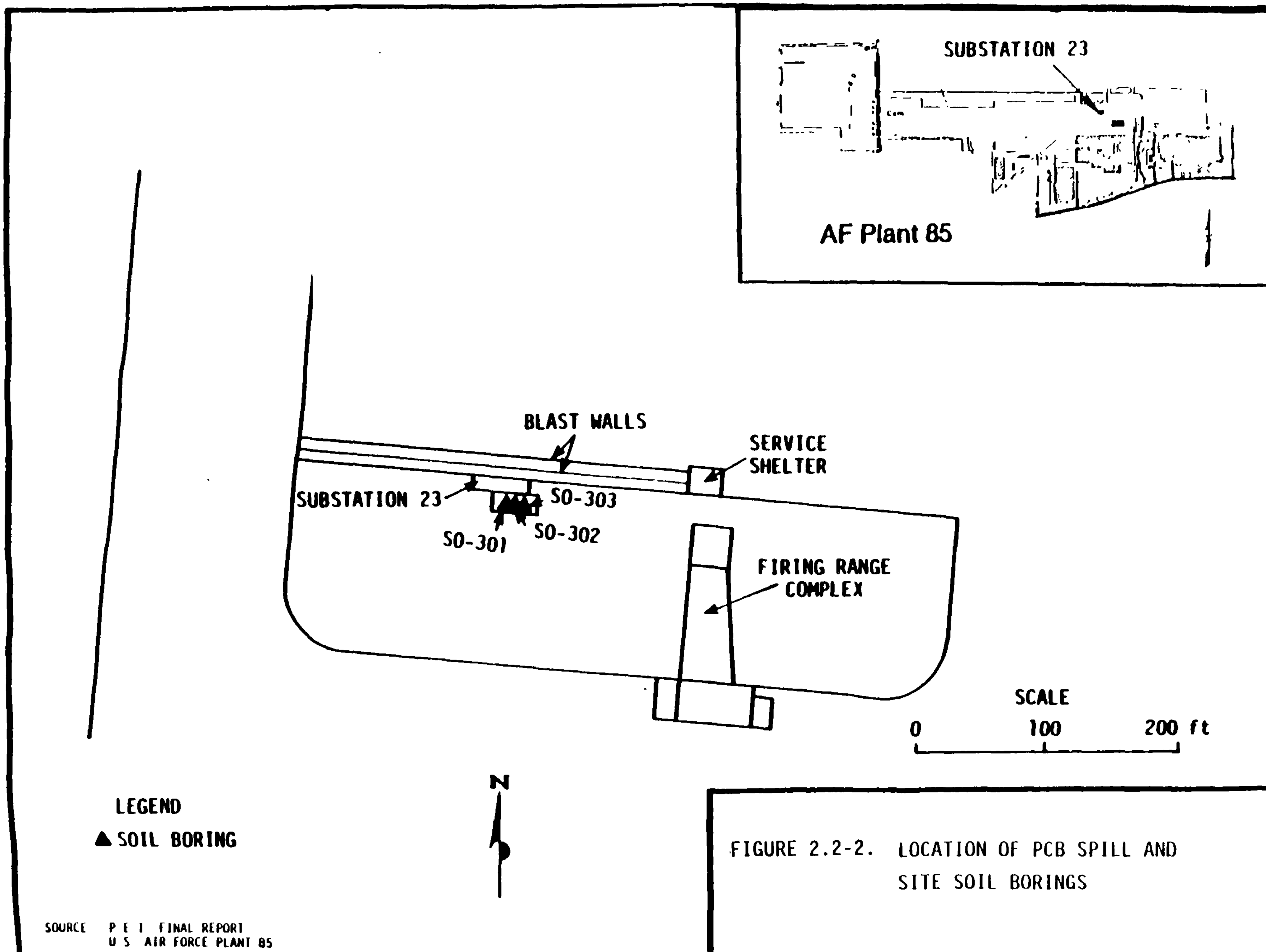


FIGURE 2.2-2. LOCATION OF PCB SPILL AND SITE SOIL BORINGS

SOURCE P E I FINAL REPORT
U S AIR FORCE PLANT 85

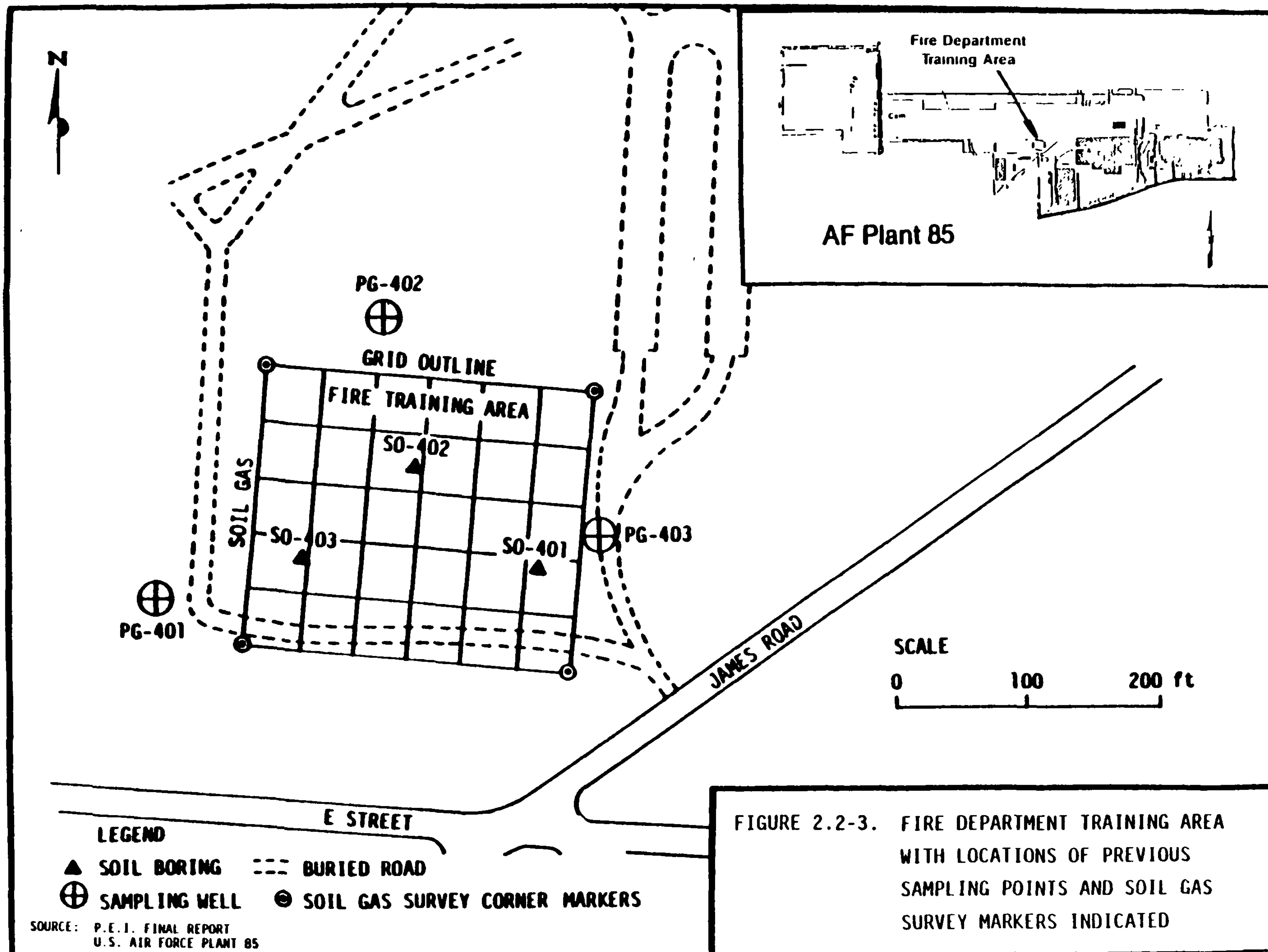


FIGURE 2.2-3. FIRE DEPARTMENT TRAINING AREA WITH LOCATIONS OF PREVIOUS SAMPLING POINTS AND SOIL GAS SURVEY MARKERS INDICATED

from one boring were checked for EP Toxicity levels based on OVA screenings of the soil samples. Permanent markers were installed at the boring locations. These borings were surveyed for elevation and location.

Three groundwater sampling wells have been installed in a triangular pattern outside the approximate burn pit area. The wells were set so that a minimum of 8 feet of the 10-foot screen was below the water table. Three soil samples from each borehole have been analyzed for oil and grease, purgeable organics, and total lead. Groundwater samples obtained from these wells were tested for TDS, pH, specific conductivity, TOX, TOC, purgeable organics, oil and grease, and dissolved lead.

Mason's Run (Site 5)

The sampling conducted to date on Mason's Run is illustrated in Figure 2.2-4. The purpose of previous investigations at Site 5, Mason's Run, was to develop upgradient and downgradient data on surface water and sediment quality, as well as groundwater quality adjacent to the entrance and exit of the stream at AF Plant 85. On March 6, 1986, surface water samples were taken where the stream enters the plant and where the stream leaves the property. Three discrete samples were collected at each station: one before plant operations began in the morning, one after the plant lunch break, and one in the evening. Collected samples were analyzed for oil and grease, TOC, TOX, purgeable organics, pH, specific conductivity, temperature, sulfate, TDS, and total dissolved concentrations of total chromium, cadmium, nickel, and lead.

Markers for staff gauges were permanently installed at the surface water sampling stations. The elevations of the bottoms of the markers were determined and tied to a U.S. Geological Survey (USGS) bench mark. Stream flow measurements and staff gauge readings were taken at the time of water sampling.

On January 6 and 8, 1986, sediment samples were collected at six locations: three each at the plant entrance and exit points of the stream. Selection of sampling locations was based on stream flow characteristics, depositional areas, and bank conditions. A volume of sample was collected with a split-spoon sampler to a depth of 6 inches below the stream bed. One portion of each sample was used for complete grain size analysis; the remaining portion

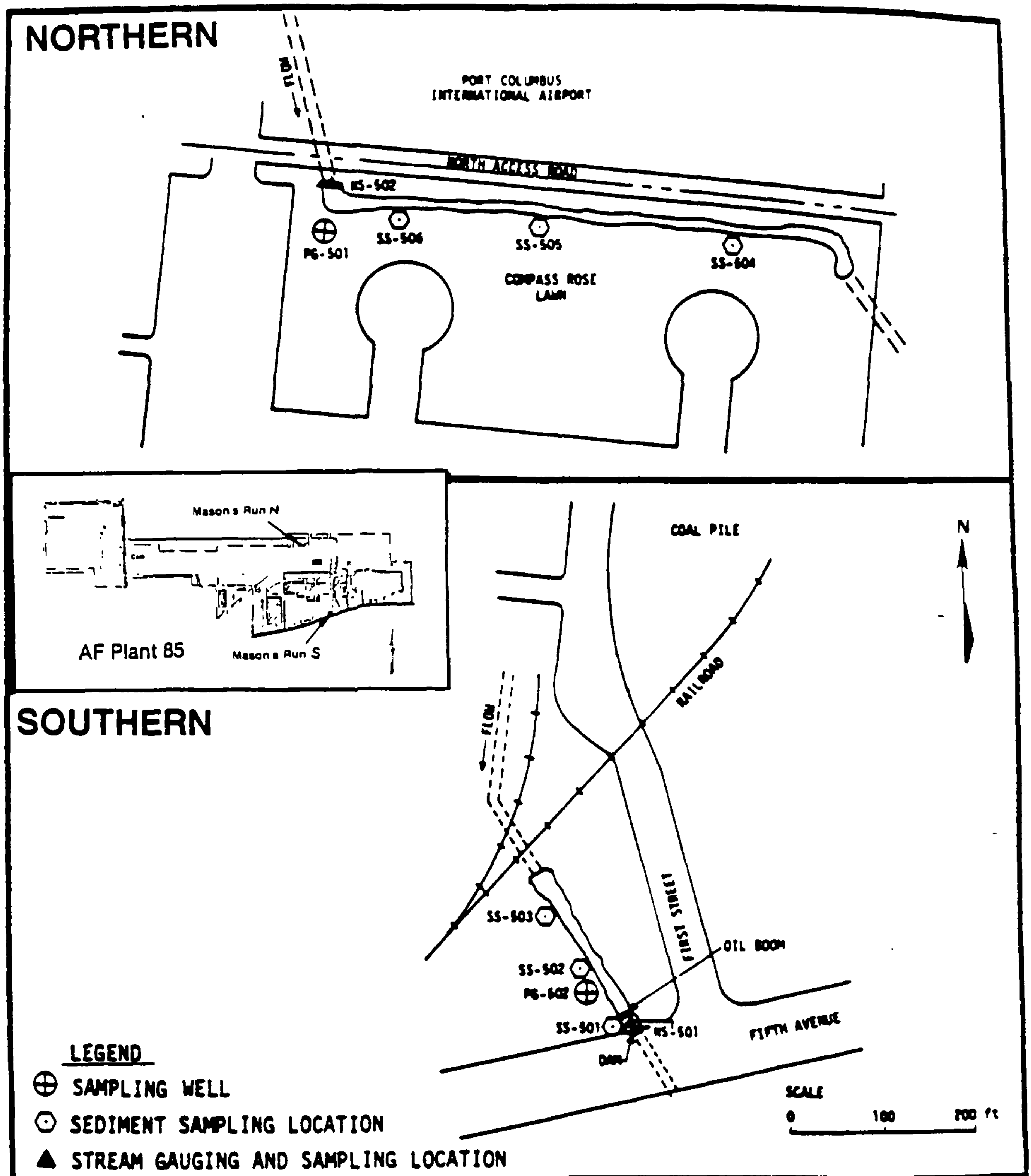


FIGURE 2.2-4. NORTHERN AND SOUTHERN AREAS OF MASON'S RUN WITH PREVIOUS SAMPLING POINT LOCATIONS

SOURCE: P.E.I. FINAL REPORT
U.S. AIR FORCE PLANT 85

was analyzed for oil and grease and concentrations of total chromium, cadmium, nickel, and lead.

Two exploratory soil borings and groundwater sampling wells have been installed: one adjacent to the point where the stream enters the plant property near the north fence, and the other at the southern exit point near the oil/water separator (oil boom). The borings were drilled by hollow-stem augers to the top of bedrock and completed as sampling wells with well screens installed along the entire saturated thickness.

Soil samples from the borings were tested for oil and grease and for concentrations of total chromium, cadmium, lead, and nickel. One groundwater sample was collected from each well and tested for oil and grease, pH, TOX, TOC, specific conductivity, purgeable organics, sulfate, and concentrations of dissolved chromium, cadmium, lead, and nickel. Cuttings from one boring were collected for the determination of EP Toxicity.

James Road Hazardous Waste Storage Pad (Site 8)

The James Road Hazardous Waste Storage Pad is depicted in Figure 2.2-5. This site has been used to store drums of hazardous wastes since 1941. These wastes include 1,1,1-trichloroethane, acetone, mixtures of other solvents, and phenolic paint strippers. Several spills have occurred on the ground adjacent to the concrete pad currently in place at this site.

Three sampling wells have been installed around the storage pad. The wells were set so that a minimum of 8 feet of the 10-foot screen was below the water table. Three soil samples from each borehole were selected for analysis based on OVA screening. The soil samples were analyzed for purgeable organics and oil and grease. Cuttings were submitted for EP Toxicity (metals only) analysis.

One groundwater sample was collected from each well and analyzed for pH, temperature, specific conductivity, TDS, TOC, TOX, purgeable organics, and oil and grease.

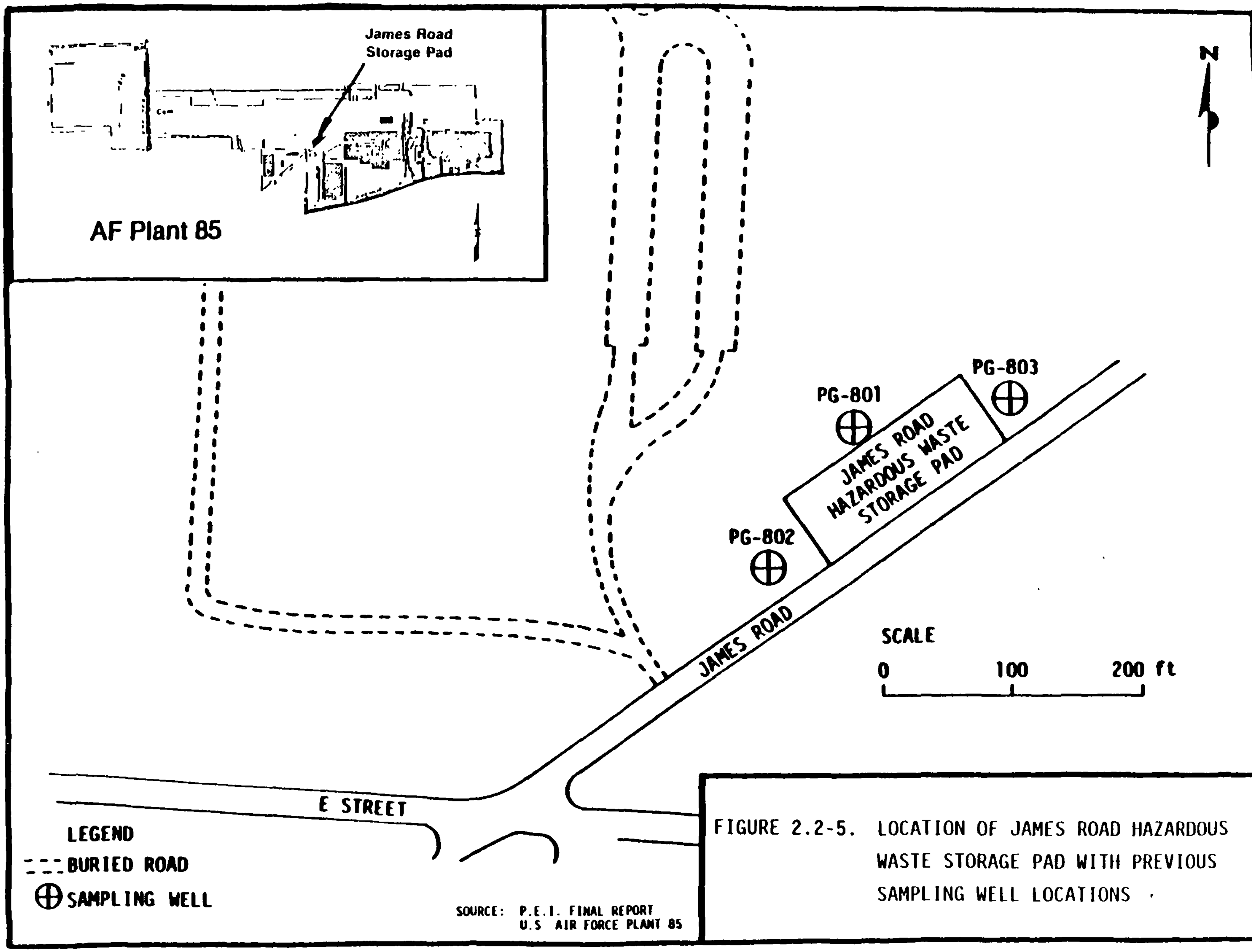


FIGURE 2.2-5. LOCATION OF JAMES ROAD HAZARDOUS WASTE STORAGE PAD WITH PREVIOUS SAMPLING WELL LOCATIONS

2.2.1 Description of Site Setting and Location

Brief descriptions of the sites are provided in the following subsections. Figure 2.1-2 shows the location of all five sites.

Coal Pile Leachate Site (Site 2)

This site is located adjacent to the plant boilerhouse, just east of Building 6 and First Street. Figure 2.2-1 delineates the approximate area of the coal pile and the location of a groundwater sampling well.

PCB Spill Site (Site 3)

This site is located adjacent to the Electric Substation 23. Figure 2.2-2 indicates the location of the site and three previous soil borings. The area encompasses approximately 60 ft^2 (12 ft x 5 ft).

Fire Department Training Area (Site 4)

The Fire Department Training Area is located just north of "E" Road and northwest of James Road. The approximate area of the site is shown in Figure 2.2-3, with locations of previous sampling points and soil gas survey markers indicated.

Mason's Run (Site 5)

This site includes the entire length of Mason's Run, which is channeled within a concrete culvert throughout most of the plant. The stream enters the plant area along the northern boundary (after passage through Port Columbus International Airport property) and discharges to an open ditch near the plant entrance gate at the intersection of First Street and Fifth Avenue. Figure 2.2-4 shows the northern and southern areas of Mason's Run, with previous sampling locations indicated.

James Road Hazardous Waste Storage Pad (Site 8)

The site is located immediately adjacent to James Road just east of the Fire Department Training Area (Figure 2.2-5). The total area of this site is approximately 9,000 ft^2 (160 ft x 56 ft).

2.2.2 Types of Waste and Concentrations

Table 2.2-2 is a summary of the results of analyses for suspected contaminants at AF Plant 85. The table presents the highest concentrations for constituents of concern identified at each site. The analytical results for each site are briefly discussed below.

Coal Pile Leachate Site (Site 2)

Water samples collected from Well 0085-PG-207 indicate that water quality appears to be generally acceptable in the area. The TDS concentration was 459 mg/l, which is below EPA's Safe Drinking Water Standards ($\leq$ 500 mg/l). Sulfate concentrations measured 42 mg/l (SDWS: < 250 mg/l). All metals and metalloids were found at very low levels except manganese, which was 0.113 mg/l (SDWS: < 0.05 mg/l).

Soil samples were analyzed for metals, sulfate, and TOX. The average concentration, in mg/kg, from samples taken from five soil borings are as follows: total chromium - 0.13; nickel - 0.10; zinc - 1.02; lead - 0.18; copper - 0.28; arsenic - 0.19; manganese - 3.70; sulfate - 15.80; and TOX - 13.20.

PCB Spill Site (Site 3)

PCB, as Arochlor 1260, was found in soils in excess of action levels (50 mg/kg) set by Toxic Substances Control Act (TSCA). Maximum sampling depth was 5 feet.

Fire Department Training Area (Site No. 4)

Soil sampling at Site 4, the Fire Department Training Area, has confirmed the presence of hydrocarbons (oil and grease) and solvents (i.e.,

TABLE 2.2-2. SUMMARY OF ANALYTICAL RESULTS OF CONSTITUENTS EXCEEDING APPLICABLE MAXIMUM CONTAMINANT LEVELS (MCLs)

Site	Media Sampled	Constituent (Concentration[a])	Remarks
Coal Pile Leachate Site (Site 2)	Groundwater	Manganese (0.113 mg/l)	Exceeds SDWS[b] (0.05 mg/l)
PCB Spill Site (Site 3)	Soil	PCB (422ug/g)	Exceeds TSCA[c] 50 ug/g action level
Fire Department Training Area (Site 4)	Soil	Toluene (140 ug/kg) Methylene chloride (180 ug/kg) Trichloroethene (160,000 ug/kg) Dichloroethane (980 ug/kg) Oil and grease (180 ug/g)	No standards for soils
	Groundwater	Nothing identified	Monitoring wells not installed at optimal locations
Mason's Run (Site 5)	Soil	Nothing identified	
	Groundwater	TDS (1162 mg/l) Sulfate (556 mg/l)	Exceeds SDWS (500 mg/l) Exceeds SDWS (250 mg/l)
	Sediment	Oil and grease (2360 ug/g) Lead (95.3 ug/g) Chromium (62.2 ug/g)	No standards for sediments
	Surface water	TDS (678 mg/l)	Exceeds SDWS (500 mg/l)
James Road Hazardous Waste Storage Pad (Site 8)	Soil	Dichloroethane (1900 ug/kg) Toluene (190 ug/kg) Oil and grease (145 ug/g)	No standards for soils
	Groundwater	TOX (1622 ug/l) trichlorotrifluoroethane (Freon 113)	Presence of Freon 113 interfered with quantification of some constituents

[a] Highest concentration identified.
[b] Secondary Drinking Water Standard.
[c] Toxic Substances Control Act.

toluene, trichloroethane, and dichloroethane) in soil at all boring locations to a depth of 16 feet. Concentrations of solvents in individual soil samples approach or exceed 1,000 ug/kg.

Data collected are inconclusive about the presence of hydrocarbons and solvents in groundwater. While no well sample had quantifiable concentrations of purgeable organics, soil samples collected below the water table had total purgeable organic concentrations of 1,000 ug/kg.

Mason's Run (Site No. 5)

Surface water, stream sediment, soil, and groundwater samples were analyzed at Mason's Run. On the day of sampling (March 6, 1986), surface water leaving AF Plant 85 via Mason's Run exceeded the SDWS for TDS and TDS levels were elevated about 30 percent above background levels. Sulfate concentrations were also elevated about this same percentage, but applicable standards were not exceeded. TOC concentrations were elevated more than 100 percent. No purgeable organics were identified leaving the site.

Stream sediment samples collected just upstream from Mason's Run discharge exhibited increased levels of all constituents analyzed, except cadmium, in comparison with upstream samples collected where Mason's Run enters AF Plant 85. Oil and grease levels were as high as 2,360 ug/g, with chromium at 62.2 ug/g and lead at 95.3 ug/g.

Soil samples did not identify any differences between background and downgradient samples. The groundwater sample from Well PG-502, the downgradient well located just north of the facility southern property line, exceeded the SDWS for TDS and sulfate, and contained concentrations of these parameters which exceeded levels detected in the background well, PG-501. Neither purgeable organics nor metals were identified at increased levels in this well.

James Road Hazardous Waste Storage Pad (Site 8)

Soil samples collected in three borings around the current pad identified the presence of hydrocarbons (oil and grease) and solvents (i.e., toluene, dichloroethane, and trichloroethane) at all three boring locations. In one boring, total solvent levels approached 1 mg/kg. Solvents were identified in a soil sample to a depth of 31.5 feet.

Groundwater samples from Well PG-803 had a TOX level of 1622 ug/l, indicating the presence of halogenated organic compounds. The presence of purgeable organic compounds has not been quantifiably determined by laboratory analyses.

2.2.3 <u>Pathways Affected</u>

Possible media (or pathways) through which contaminants may have or might migrate from AF Plant 85 include surface water (Site 5, Mason's Run), groundwater, and air. The least probable of these is air. Organic contaminants and PCBs are present in soils which could become airborne; however, all sites are vegetated, therefore minimizing fugitive dust.

Contaminants may migrate offsite in Mason's Run as dissolved or suspended materials. High levels of oil and grease, lead, and cadmium are present in sediments just upstream from Mason's Run discharge from AF Plant 85. These materials could be transported offsite during flood conditions. Water quality in Mason's Run has been degraded to some degree, causing increased levels of dissolved inorganic constituents. No constituent exceeded a Primary Drinking Water Standard (PDWS), but the SDWS for TDS was exceeded. Water and sediment from Mason's Run ultimately discharge to Alum Creek several thousand feet south of the plant.

Data at Site 8, the James Road Hazardous Waste Storage Pad, indicate that purgeable organics are present in groundwater, and data from Site 4, the Fire Department Training Area, indicate soil contamination which also suggests possible groundwater contamination. Both of these locations are several hundred feet from the plant property line.

Groundwater is also a possible migration media for dissolved inorganic constituents identified in Well 0085-PG-502, located within 200 feet of the most downgradient limit of the plant property. SDWS for both TDS and sulfate have been exceeded. No organics evaluated during the IRP Phase II Stage 1 investigation were identified in this well.

3.0 ENVIRONMENTAL SETTING

Most of the information on the environmental setting at AF Plant 85 was obtained from "Installation Restoration Program Records Search for Air Force Plant 85, Ohio" (CH2M-Hill, 1984) and "IRP Phase II, Stage 1, Initial Quantification of Contamination at Air Force Plant 85, Columbus, Ohio" (PEI Associates, Inc., 1986), except as indicated otherwise.

3.1 GEOGRAPHICAL SETTING

AF Plant 85 is located in Franklin County in central Ohio. It is within the boundaries of the City of Columbus, about 6 miles northeast of the downtown area. The plant is adjacent to Port Columbus International Airport.

3.1.1 Physiography

AF Plant 85 is located within the glaciated Till Plains of Central Ohio, a division of the Central Lowlands physiographic province.

A series of north-south trending escarpments and terraces separates the Central Lowlands from the Appalachian Plateau east of Columbus. The lowest of these escarpments rises from an altitude of 800 feet on their western edge to approximately 1,010 feet National Vertical Ground Data (NVGD) on their eastern edge. Big Walnut Creek, located about a mile east of AF Plant 85, is near the base of these escarpments.

Drainage in the central Ohio area is confined to the Scioto River Basin, which drains approximately 6,517 square miles. The Scioto River, the principal river in the system, flows southward through downtown Columbus to the Ohio River. Major tributary streams to the Scioto River include the Olentangy River, Alum Creek, and Big Walnut Creek, which have a parallel north-south alignment (see Figure 2.1-1). These streams are controlled by reservoirs located north of AF Plant 85, in Delaware County.

3.1.2 Topography

Surface elevations in Franklin County range from 1,130 feet in the northeast corner to 670 feet NVGD along the southern border where the Scioto River leaves the county. The ground surface is relatively flat, with the only significant relief occurring in glacial moraines, resistant bedrock, or areas adjacent to streams. The topography of AF Plant 85 is relatively flat (slopes average between 0 and 6 percent); elevations vary from 800 to 810 feet NVGD. Areas at the airport which border Big Walnut Creek exhibit the greatest slope while paved areas of the airport area have slopes of less than 1 percent (City of Columbus, 1978).

3.2 GEOLOGY

3.2.1 Geologic Setting

The geologic setting in the central Ohio area consists of sedimentary rocks that are overlain by glacial deposits, alluvium, and soil (Table 3.2-1). The sedimentary rocks of the area are sandstones, shales, and carbonates (limestone and dolomite). Work conducted during Phase II Stage 1 stressed sample collection and analysis at each of the five investigated sites. This resulted in a further understanding of the glacial and bedrock geology. There were twelve borings drilled (depths: 16.5 to 51.5 ft.) during Phase II Stage 1 but only four penetrated more than one type of soil material and only two borings penetrated bedrock.

Two geologic cross sections were constructed based on the borings. Samples of unconsolidated materials were identified and analyzed for lithologic characteristics. The two borings that penetrated bedrock enabled a better estimation of depth to bedrock at the site and provided samples of the Ohio - Olentangy Shale Formation which directly underlies the glacial sediments at the site. These findings are presented in the following sections.

TABLE 3.2-1. GEOLOGIC FORMATIONS IN THE VICINITY
OF AF PLANT 85, FRANKLIN COUNTY, OHIO

System	Series	Group or Formation	Maximum thickness, (feet)	Character of material	Water-bearing properties
	Recent (alluvium)			Silt, clay, and sand deposited on the flood plains of the major streams.	Thin and relatively impermeable.
		Later Stage Wisconsin Period	50-100	Clayey till (glacial till).	Yields less and 2 gpm.
Quaternary	Pleistocene (glacial)	Early Stage Wisconsin Period	0-350	Sand and gravel (glacial outwash) buried valleys. Layer of clayey till may be present below outwash.	Potential groundwater yields depend upon the thickness, regional extent, permeability and source of recharge. Where favorable conditions prevail, wells may yield 1,000 to 1,500 gpm. Typically, wells yield 200 gpm. Where sand and gravel are present in thin scattered lenses interbedded with glacial till, yields are as low as 5 to 10 gpm.
		Illinoian Period	0-85	Lenses of fine sand in buried valleys.	Generally not a source of groundwater. Usually low in permeability.
		Cuyahoga	165	Alternating gray, sandy shale and blue to grayish sandstone.	Potential yields of up to 30 gpm from sandstone layers.
		Sunbury	35	Black shale.	Poor source of groundwater.

TABLE 3.2-1. GEOLOGIC FORMATIONS IN THE VICINITY OF AF PLANT 85, FRANKLIN COUNTY, OHIO (CONTINUED)

System	Series	Group or Formation	Maximum thickness, (feet)	Character of material	Water-bearing properties
Mississippian		Berea	5-55	Gray to buff-colored sandstone with some shale.	Potential yields of up to 25 gpm.
		Bedford	60-90	Brown to gray shale.	Poor source of groundwater.
		Ohio	450	Black shale.	Poor source of groundwater.
		Olentangy	30	Blue shale with some limestone concretions.	Poor source of groundwater.
		Delaware	32	Blue-gray limestone with some thin shaley layers, iron pyrites, and black chert.	Small supplies of up to 3 gpm.
Devonian		Columbus	105	Brown to light gray porous limestone.	The principal bedrock aquifer in the county for farm, domestic, small municipal, and industrial supplies. Yields up to 175 gpm.
		Rasin River	373	Dolomitic limestone.	Most important industrial bedrock aquifer. Yields up to 400 gpm or more, usually higher mineralized.

Source: Bulletin 30, Ohio Department of Natural Resources as cited in CH2M-Hill, 1984.

3.2.2 Bedrock Geology

The sedimentary bedrock of central Ohio ranges in age from 340 to 410 million years (Late Silurian to Early Mississippian). The rock consists of beds of dolomitic limestone, black shale, and alternating shale and sandstone. These units strike approximately north-south and dip 20 to 30 feet per mile to the east toward the Appalachian Basin. The principal rock units and their areal distribution are shown in Figure 3.2-1. Some of these rock units have been removed locally by erosion and are therefore absent in parts of the county. Figure 3.2-2 shows an east to west geologic cross-section of Franklin County.

Erosion in the area of AF Plant 85 prior to deposition of glacial materials has removed some of the rock units listed in the geologic column (Table 3.2-1). The bedrock formation directly underlying AF Plant 85 is the Ohio-Olentangy Shale. Sampling during Phase II Stage 1 revealed that at AF Plant 85 this formation is dark gray to black, thinly bedded, and weathered to the maximum 0.5-foot depth sampled. Depth to bedrock is about 44 feet at borehole 0085-PG-501 and 50 feet at borehole 0085-PG-502.

An extensive erosional and drainage system with considerable relief was developed on the bedrock surface prior to glaciation, as is illustrated in Figure 3.2-3, the bedrock topography map. The bedrock surface in the central and western portions of Franklin County is distinguished by a low plateau with a rolling surface characteristic of extensive erosional development. The main buried channel, known as the preglacial Groveport River, is located in southeastern Franklin County about 9 miles south of AF Plant 85. A major tributary to the preglacial Groveport River flowed beneath the present-day plant from the area of Gahanna to Bexley, and then southward to its confluence with the preglacial Groveport River along the general course of present-day Alum Creek. This buried valley is at a depth of approximately 200 feet below the present ground surface in the area of AF Plant 85, as illustrated in Figure 3.2-2. Prominent, buried, north-south trending bedrock escarpments are present in the eastern portion of Franklin County. A buried bedrock escarpment is just east of AF Plant 85. These step-like escarpments increase in elevation to the east and younger-age lithologic units are encountered.

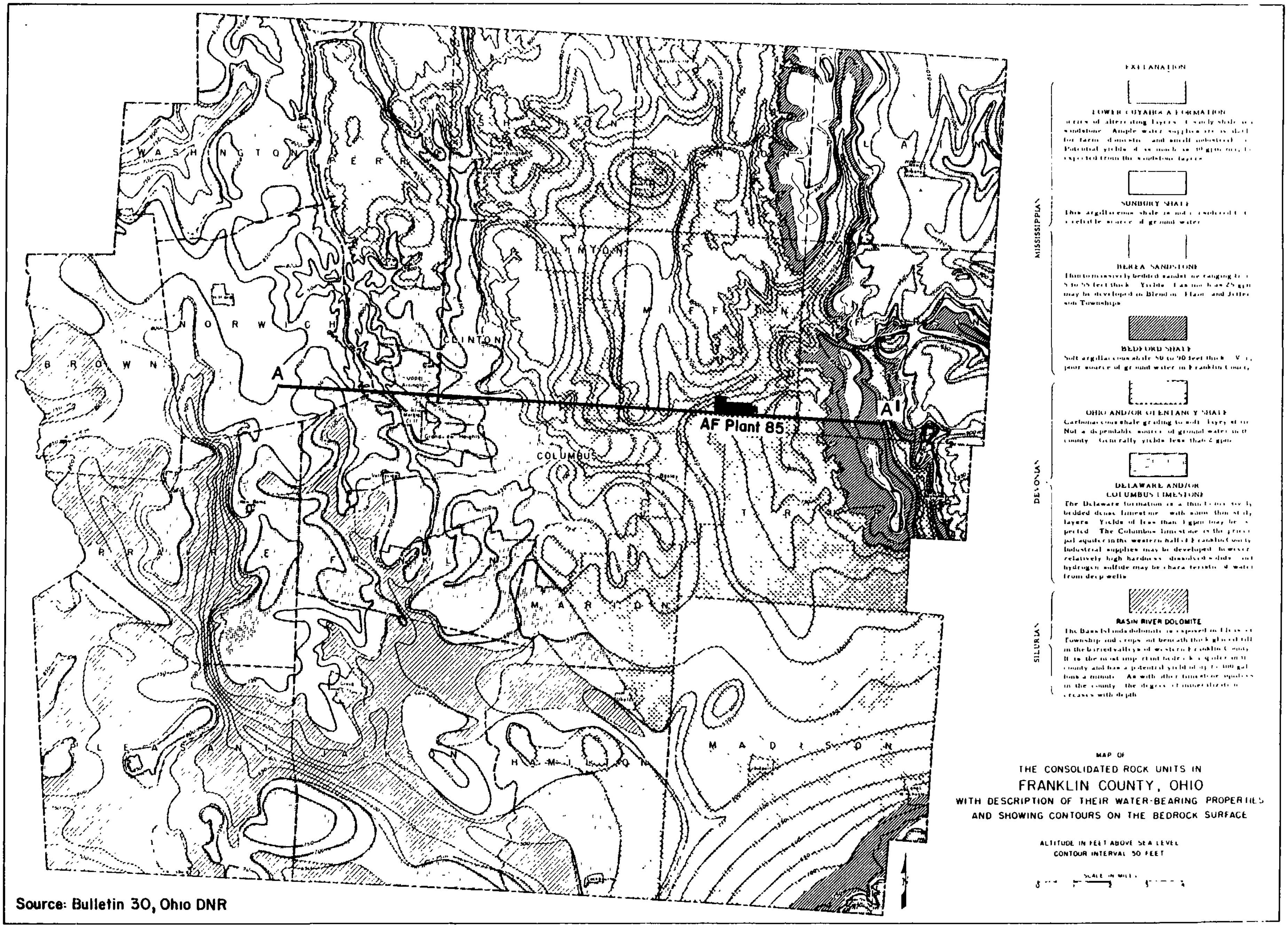
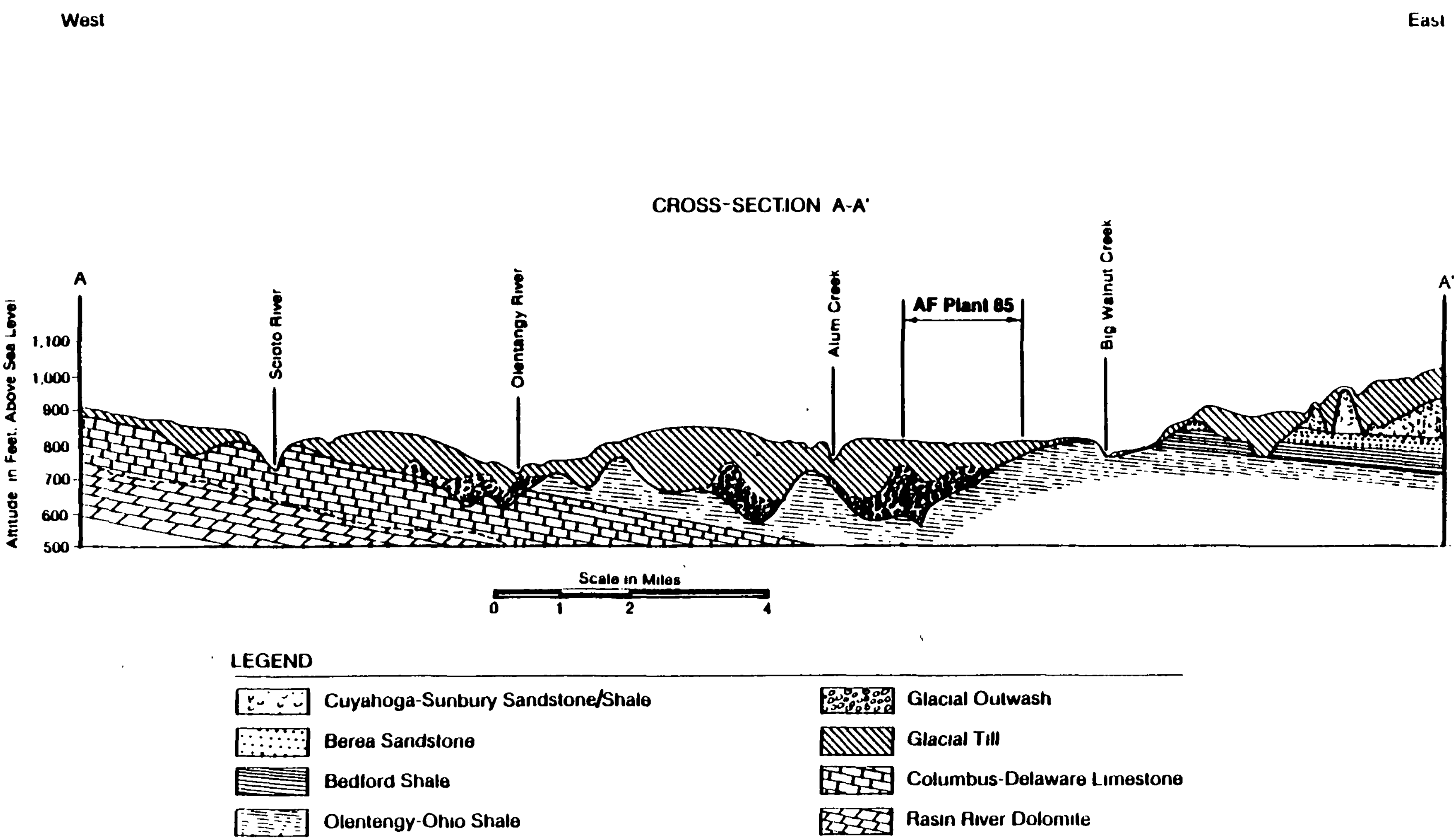


FIGURE 3.2-1. AREAL DISTRIBUTION OF PRINCIPAL ROCK UNITS IN FRANKLIN COUNTY, OHIO



Source Bulletin 30, Ohio DNR

FIGURE 3.2-2. GENERALIZED GEOLOGIC CROSS SECTION OF FRANKLIN COUNTY, OHIO

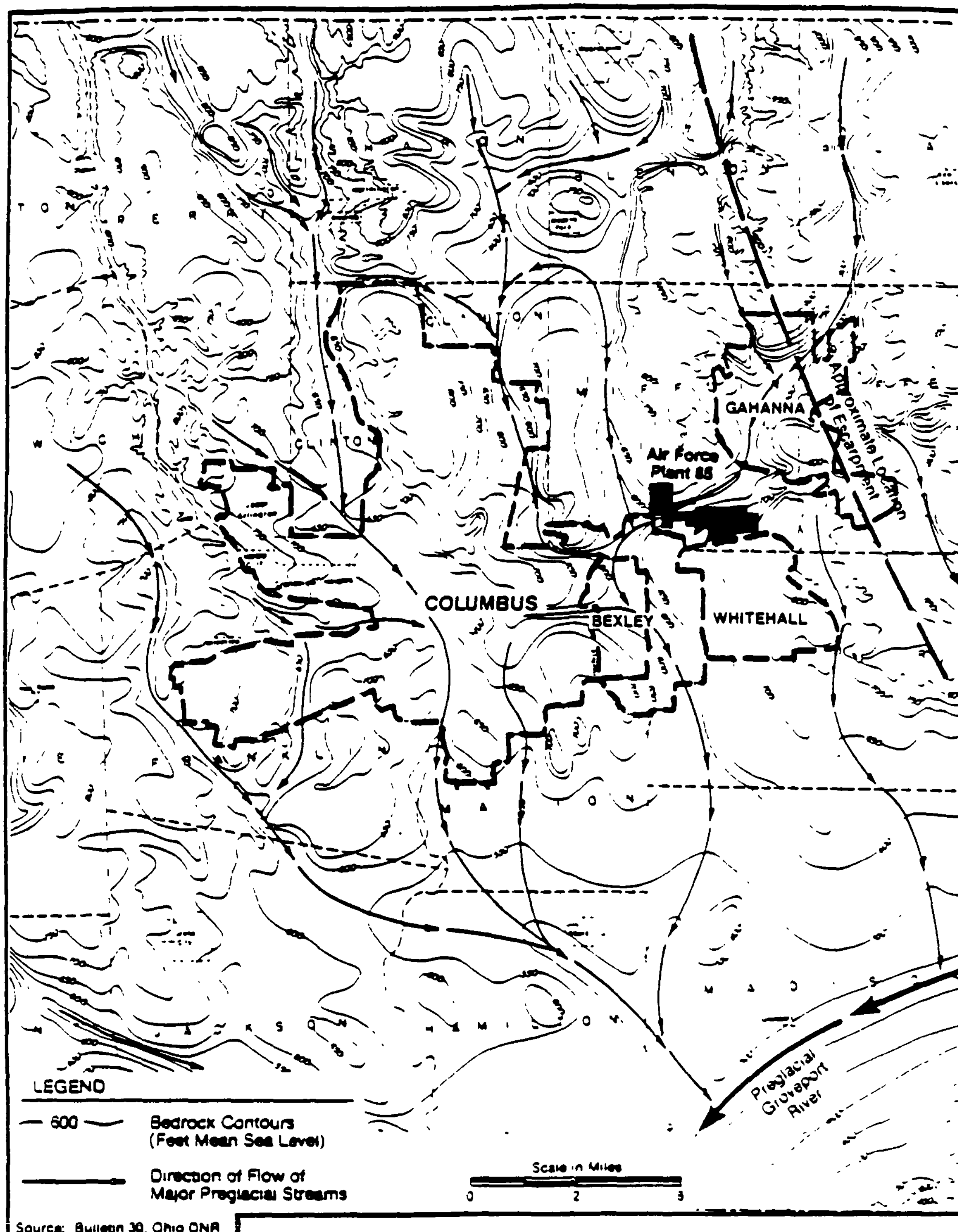


FIGURE 3.2-3. BEDROCK TOPOGRAPHY OF FRANKLIN COUNTY, OHIO

The oldest rock unit of the Devonian system is the Rasin River Formation, a dolomitic limestone which is exposed in places in the western part of the county. The formations to the east are progressively younger and overlie the Rasin River. They include the Columbus and Delaware Limestones, and the Ohio and Olentangy Shales. The Mississippian System is exposed in the valleys east of Big Walnut Creek. The formations include, from oldest to youngest, the Bedford Shale, the Berea Sandstone, the Sunbury Shale, and the Cuyahoga Sandstone. These formations are located east of Big Walnut Creek and are therefore not present at AF Plant 85.

3.2.3 Surficial Geology

3.2.3.1 Glacial Deposits

Central Ohio was glaciated during at least two recent glacial periods, the Illinoisan and the Wisconsin. Illinoisan glaciation left fine, well-sorted sands and gravels in the bottom of the deep preglacial bedrock valleys. Wisconsin glaciation can be divided into two stages, early and late. Early Wisconsin glaciation left a thin layer of relatively impermeable clay-rich till deposited directly by the ice. The clay-rich till was then overlain by a relatively well-sorted and stratified sand and gravel layer, between 5 and 100 feet thick.

The second Wisconsin glacial stage left a second layer of till on top the outwash deposits and bedrock. This till forms the primary surface deposit in the county, averaging 50 feet in thickness. In the northeastern part of the county, where AF Plant 85 is located, the till consists of a medium-fine clay loam that contains a high percentage of sandstone and coarse shale fragments from the underlying bedrock.

A review of soil borings and well logs in the vicinity of AF Plant 85 indicates that the subsurface conditions in the eastern portion of the plant consist of less than 15 feet of clayey till over shale bedrock. The bedrock surface drops sharply to the west; along the western portion of the plant, the subsurface conditions consist of approximately 50 feet of clayey till over sand and gravel outwash deposits. Shale bedrock in this area is present at a depth of approximately 200 feet.

During the Phase II Stage 1 field work, split-spoon samples were taken at 12 boreholes. The soils contained in these samples were visually identified, detailed boring logs were prepared (presented as Appendix D of the IRP Phase II Stage 1 report), and two geologic cross sections were constructed. The cross sections are presented as Figures 3.2-4 and 3.2-5 of this report. Figure 3.2-6 shows the locations of these cross sections at the site. The sample analysis and geologic interpretations that have been made fit into the framework of the regional geology as it is now understood.

Cross Section A-A' (Figure 3.2-4) shows the relationship of the three near-surface geologic units at the site: Wisconsin till, Illinoisan outwash and Ohio-Olentangy Shale. Sample analysis indicates that the uppermost Wisconsin till, which may be locally overlain by fill material, is a heterogeneous, nonsorted mixture of predominantly clay-sized particles with some silt, sand, gravel, and rock fragments. The unit is brown to gray and is slightly to moderately plastic. Distinct silty to sandy lenses are identified, but they do not appear to be continuous or interconnected.

As the cross section illustrates, the Wisconsin till present along the section varies in thickness from 24 to 36 feet thick. Cross Section B-B' (Figure 3.2-5) indicates that in the western part of the plant, the Wisconsin till is about 30 feet thick.

Wisconsin and Illinoisan-aged glacial outwash underlies the Wisconsin till at the plant. As the cross sections indicated, outwash sediments have a maximum thickness of 18 to 20 feet and consist of clayey and silty gravel.

3.2.3.2 Soils

Soils present at AF Plant 85 belong to the Bennington-Pewamo Association. These soils are formed in fine-textured glacial till on relatively flat upland surfaces. The Bennington Series soils consist of yellowish-brown silty clay loams that percolate slowly, are generally wet, and are easily eroded. Bennington soils occupy nearly level topography and gently sloping knolls and ridges. The Pewamo Series soils consist of gray clay loams, which are generally wet to ponded, easily eroded, and percolate slowly. Pewamo soils occur in broad flats and depressions. The distribution of these soils at AF Plant 85 is shown in Figure 3.2-7. The distinction made between the

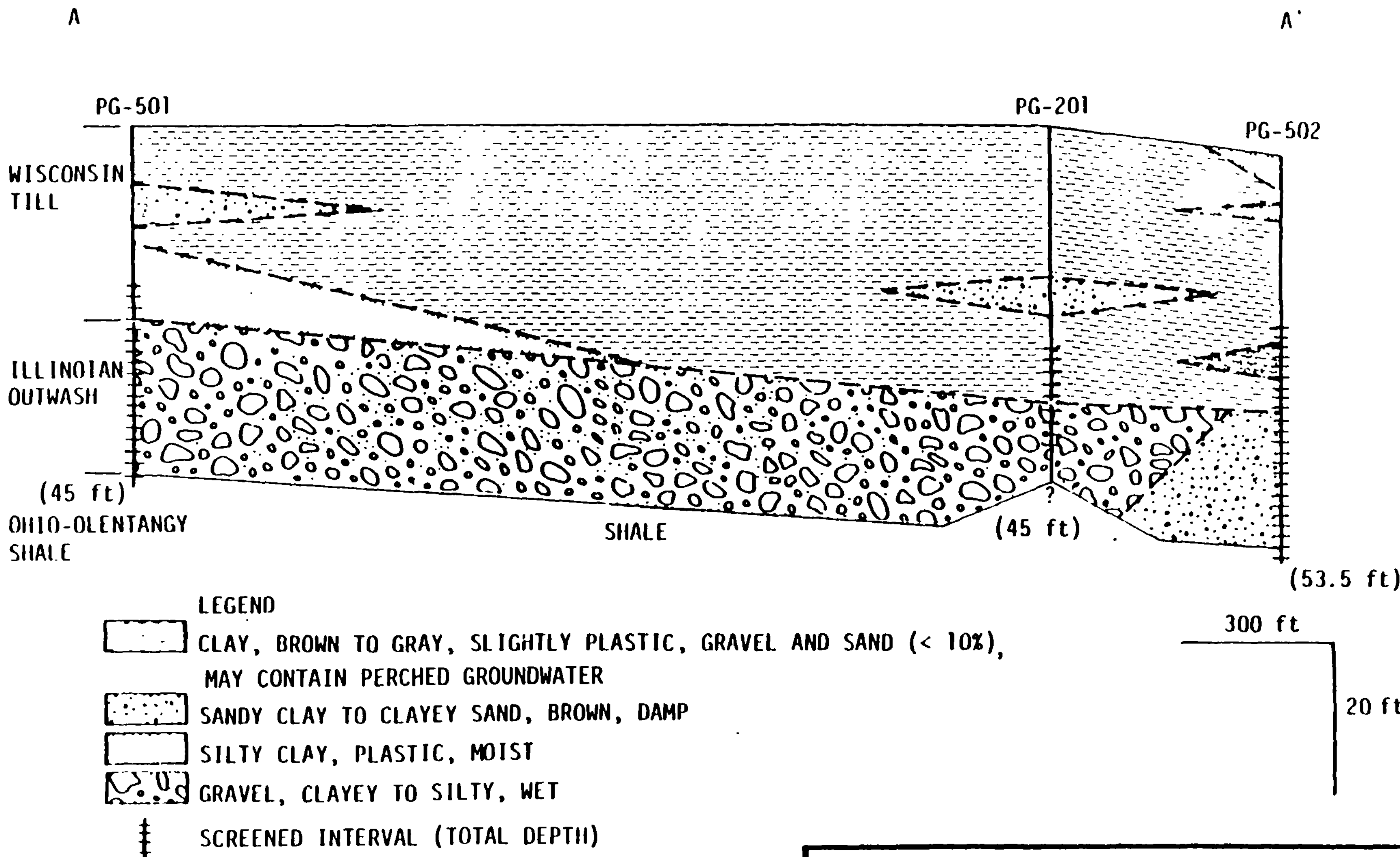
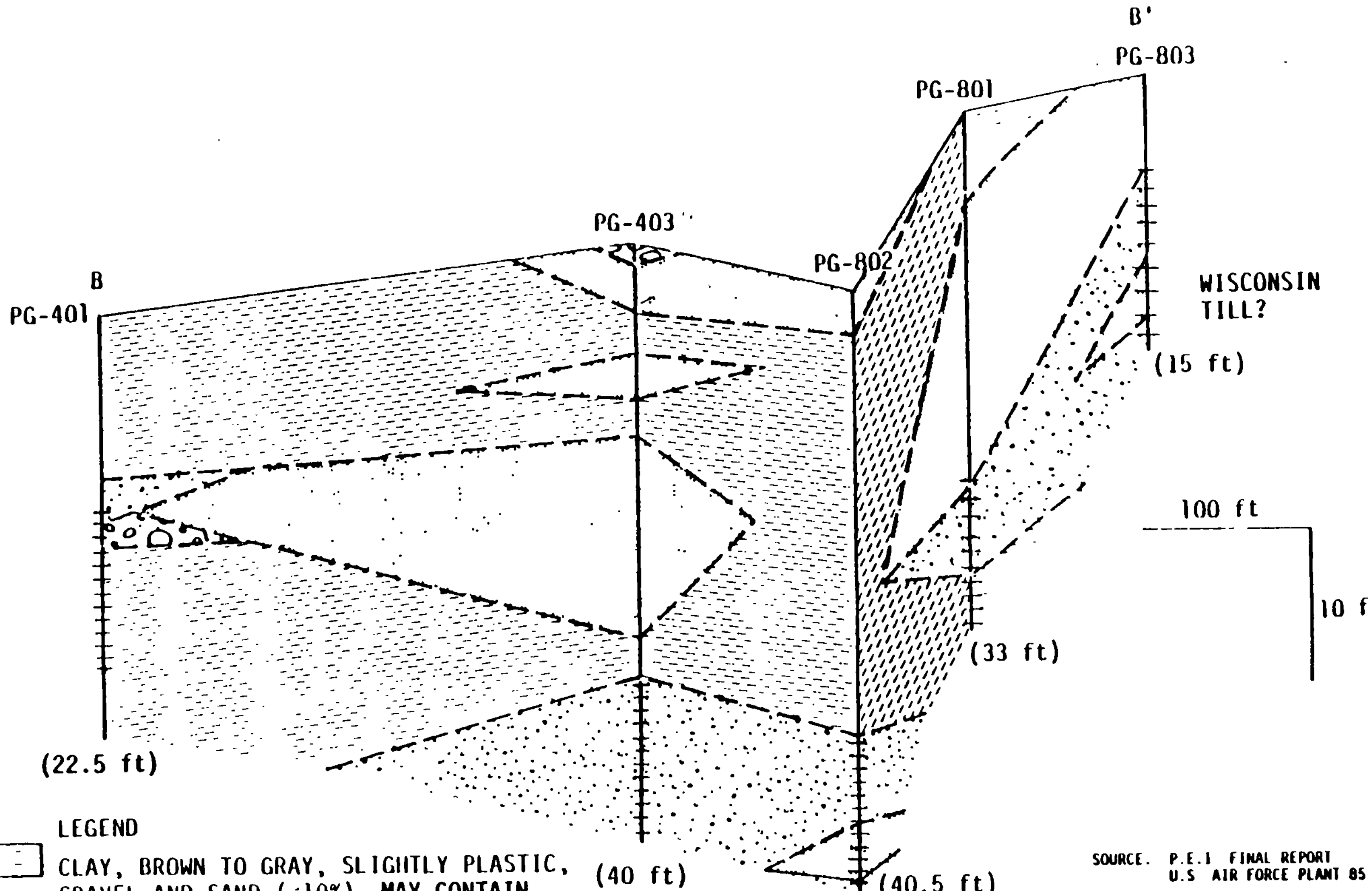


FIGURE 3.2-4. GEOLOGIC CROSS SECTION (A-A'), AF PLANT 85

SOURCE. P.E I. FINAL REPORT
U S AIR FORCE PLANT 85



LEGEND

- CLAY, BROWN TO GRAY, SLIGHTLY PLASTIC, GRAVEL AND SAND (<10%), MAY CONTAIN PERCHED GROUNDWATER
- SANDY CLAY TO CLAYEY SAND, BROWN, DAMP
- SILTY CLAY, PLASTIC, MOIST
- GRAVEL, CLAYEY TO SILTY, WET
- SCREENED INTERVAL (TOTAL DEPTH)

SOURCE. P.E.I FINAL REPORT U.S AIR FORCE PLANT 85

FIGURE 3.2-5. GEOLOGIC CROSS SECTION (B-B'), AF PLANT 85

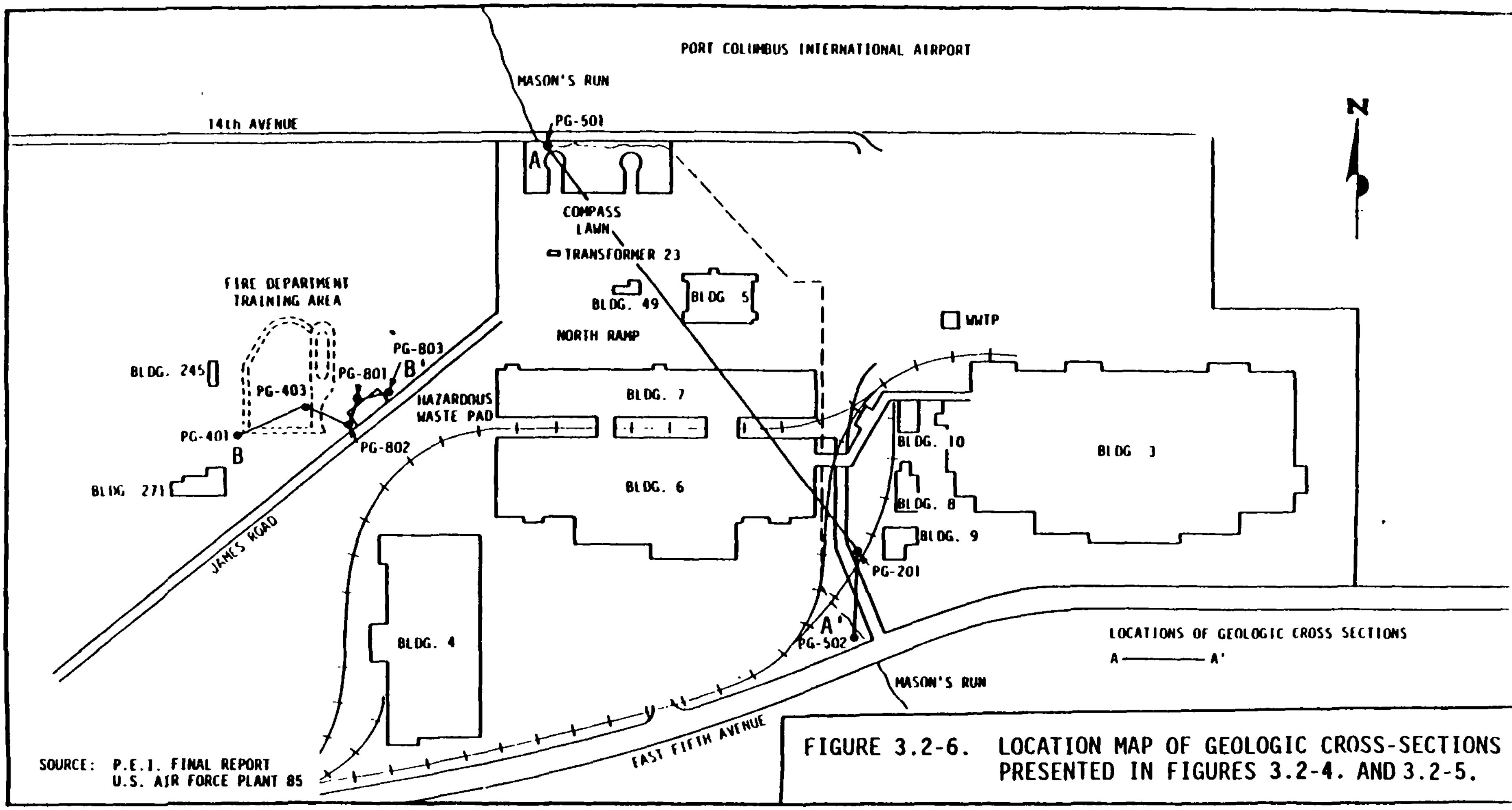


FIGURE 3.2-6. LOCATION MAP OF GEOLOGIC CROSS-SECTIONS PRESENTED IN FIGURES 3.2-4. AND 3.2-5.

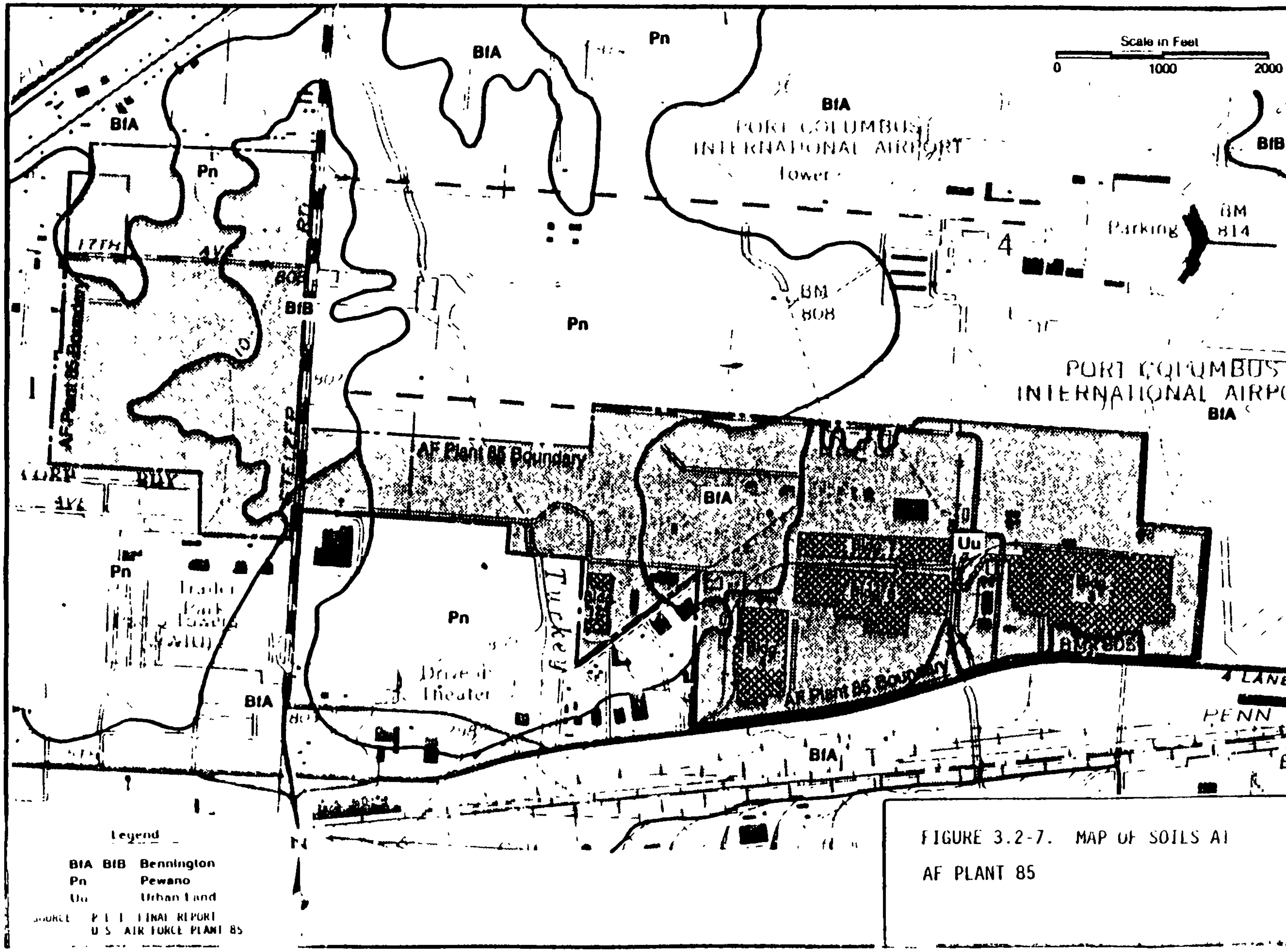


FIGURE 3.2-7. MAP OF SOILS AT AF PLANT 85

Bennington and Pewamo Series soils is based on their topographic setting and how well they are drained. Since they were deposited together, are associated with each other, and are from the same parent material, it is unlikely that there is any significant difference in their retardation characteristics.

The soils at the plant are considered urban land complexes and generally have slopes ranging from 0 to 6 percent. Table 3.2-2 lists the soil series at AF Plant 85 and the characteristic engineering properties of the soil types.

3.3 HYDROGEOLOGY

3.3.1 Surface Water

The major streams that flow through Franklin County are the Scioto and Olentangy Rivers and Alum and Big Walnut Creeks. The streams are approximately parallel, flowing north to south, and eventually join the Scioto River in the southern part of Columbus. The Scioto and Olentangy Rivers are considered navigable by the U.S. Army Corps of Engineers. There is an extensive network of reservoirs in the county which have been built for flood control and water supply purposes.

AF Plant 85 is located within the drainage basin of Big Walnut Creek. The general direction of surface water drainage at AF Plant 85 is shown in Figure 3.3-1. Surface water runoff from the plant discharges into two creeks: Turkey Run, located in the western portion of the site, and Mason's Run, located in the central plant area. Both streams enter the plant site from Port Columbus International Airport to the north and flow southward, eventually joining Big Walnut Creek about 5 miles south of the site. Flow within these creeks is generally low except during times of precipitation. Flooding is limited to the localized creek beds. Due to the large proportion of paved area and relatively impermeable surface soils, surface runoff is highly dependent on recent storm events.

An extensive stormwater drainage system has been constructed throughout the main plant area, which discharges to Mason's Run at the plant entrance gate.

TABLE 3.2-2. SOIL TYPES AT AF PLANT 85

Soil Name	Map Symbol	Characteristic Permeability (cm/sec)	SCS[a] Hydrologic Group	Typical Percent Passing No. 200 Sieve	Typical Liquid Limit	Typical Unified Soil Classification
Bennington--Urban Land Complex	B_fA, B_fB	$4x10^{-5}$ to $1x10^{-4}$	C	70-100	30-50	CL
Pewamo--Urban Land Complex	P_n	$1x10^{-4}$ to $4x10^{-4}$	B/D	75-95	35-55	CL, CH
Urban Land--Bennington Complex	U_u	$4x10^{-5}$ to $4x10^{-4}$	C	70-100	30 50	CL

Source: U.S.D.A. Soil Conservation Service as cited in CH2M-Hill, 1984.

[a]Soil Conservation Service

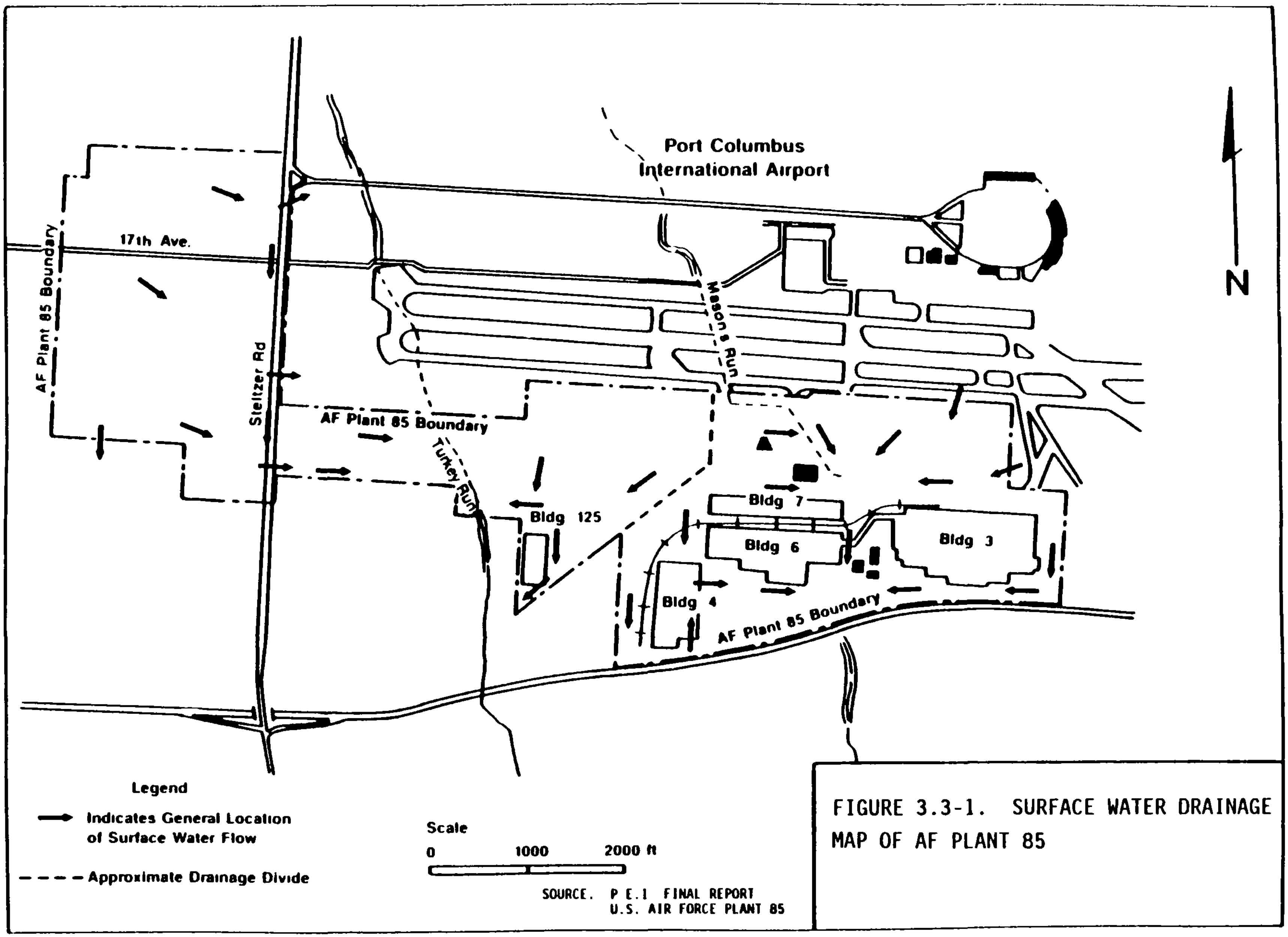


FIGURE 3.3-1. SURFACE WATER DRAINAGE MAP OF AF PLANT 85

3.3.2 Groundwater

Groundwater in Franklin County is present in three general aquifer systems: Devonian limestone aquifers, Mississippian sandstone aquifers (not present at AF Plant 85), and glacial outwash aquifers.

The lower Devonian rocks, principally the Rasin River and Columbus Limestones, are major sources of groundwater supply in western Franklin County (about 5 miles west of the plant). These carbonate units supply about a third of all groundwater used in Franklin County and yield 175 to 400 gallons per minute (gpm) to individual wells. Groundwater is present in fractures, joints, and crevices within the limestone; well yields are therefore dependent on rock solubility and extent of solutioning within the limestone.

The Devonian and Mississippian shales, such as the Ohio-Olentangy Shale immediately underlying AF Plant 85, are relatively impermeable deposits which are seldom used for water supply except in limited weathered zones. The shales serve as an effective confining layer separating the artesian limestone aquifers from the more permeable overlying deposits.

East of Big Walnut Creek, Mississippian-age sandstones, primarily the Berea and lower Cuyahoga Sandstones, are relatively permeable deposits which may yield between 25 and 70 gpm of groundwater. The higher yields are obtained primarily in highly fractured zones. The deposits are not major sources of groundwater in Franklin County, however, because of a lack of fractures and the thinness of the strata. Groundwater supply and production in the glacial aquifer are highly variable. Permeable glacial outwash (sands and gravels) in buried valleys associated with the Scioto, Olentangy, and Big Walnut streams are the major groundwater aquifers in Franklin County. These aquifers have potential yields of 1,000 to 1,500 gpm when connected hydraulically with the streams.

Although the details of the hydrogeologic system at AF Plant 85 are still rather unclear, by knowing the regional bedrock topography and the regional hydraulic characteristics of the overlying glacial sediments, some general interpretations can be made. The southwestern portion of AF Plant 85 is underlain by glacial outwash associated with a buried preglacial bedrock valley. This outwash is capped by 10 to 50 feet of clay till, which also covers the bedrock on the entire AF Plant 85 site. The thick till reduces the amount of rainfall infiltration and local recharge, resulting in lower well yields than for sand and gravel deposits in direct contact with surface streams. However, yields of as much as 200 gpm may be obtained.

Most of the remaining portion of the plant is underlain by lenses of sand and gravel interbedded in the clayey till which overlies the shale bedrock. Yields of as much as 25 gpm are typically obtained north of 17th Avenue where the deposits can reach 200 feet in thickness within a buried bedrock valley. In the area of Site 5, Mason's Run, yields from irregular and thinly scattered sand and gravel lenses are only 5 to 10 gpm. The eastern portion of the site between Mason's Run and Big Walnut Creek is underlain by thin glacial till over relatively impervious shale; well yields are typically less than 2 gpm in this area.

The principal groundwater aquifer in the vicinity of AF Plant 85 is in the glacial deposits overlying the impermeable shales. For the most part, recharge to this aquifer occurs through infiltration from creeks during the spring, including Mason's Run, Turkey Run, Alum Creek, and Big Walnut Creek. Minor recharge also occurs as direct infiltration of precipitation through the glacial deposits. Groundwater discharges chiefly to major streams during the fall. Hence, the water table usually declines persistently throughout the summer, reaching its lowest stage in the fall and its highest stage in the early spring.

The shape of the groundwater table is controlled by both surface and bedrock topography. The groundwater table generally follows the slope of the overlying topography, being higher in the uplands than in the valleys. Regional groundwater flow is generally toward major streams and rivers. During periods of heavy precipitation or flooding, however, groundwater flow may be reversed, raising the groundwater table adjacent to streams.

Since AF Plant 85 straddles a bedrock valley (Figure 3.2-3), the direction of groundwater flow is likely to vary beneath it as flow follows the slope of the underlying bedrock, before discharging into Alum Creek. The depth to the groundwater table varies from 10 feet in the eastern portion of the plant to 50 feet in the western portion. The horizontal-groundwater gradient is therefore about 20 feet per mile. .

Due to the variability of the glacial sediments at the plant (Figures 3.2-4 and 3.2-5), perched groundwater may be present within the clayey glacial till deposits above the regional groundwater table. This is a common but temporary condition, which follows a period of precipitation and infiltration, in clayey soils. If present, perched groundwater is of limited thickness and of local extent, but may contribute to saturated soil conditions near the ground surface in many areas.

Water quality within the glacial aquifers is generally good, although the water is typically high in hardness and is usually treated for the removal of iron. Characteristic analyses of the various groundwaters are summarized in Table 3.3-1.

3.3.3 Water Use

3.3.3.1 Surface Water Use

Surface waters are the primary source of municipal water supplies in Franklin County. The Columbus Division of Water supplies the City of Columbus and thirteen neighboring communities with water. The Morse Road Treatment Plant, which provides water to AF Plant 85, is supplied by Hoover Reservoir and serves the northern and eastern portions of the Columbus area. Hoover Reservoir, located 8 miles north of AF Plant 85 on Big Walnut Creek, is used for both water supply and flood control (City of Columbus, 1978).

3.3.3.2 Groundwater Use

Numerous private water supply wells have been drilled in the vicinity of AF Plant 85. These wells have been developed in the glacial outwash deposits and do not penetrate through the underlying relatively impermeable shale. A total of approximately 1,000 wells may be located within a 3-mile radius of the plant; however, most of these wells have been abandoned. The City of Columbus operates a municipal water supply system which now serves the entire area including the towns of Bexley, Whitehall, and Gahanna. The City of Columbus does not require residences to use the municipal supply and maintains no record of which residences have not hooked up. Most residences are connected to the municipal water supply. It is estimated, however, that between 50 and 100 private wells may still be in service within a 3-mile radius

TABLE 3.3-1. CHARACTERISTIC ANALYSES OF GROUNDWATER IN THE VICINITY OF AF PLANT 85, FRANKLIN COUNTY, OHIO

Aquifer Source	pH	Specific Conductance (umhos)	Iron (ppm)	Calcium (ppm)	Magnesium (ppm)	Bicarbonate (ppm)	Sulfate (ppm)	Hydrogen Sulfide (ppm)	Chloride (ppm)	Dissolved Solids (ppm)	Hardness as $CaCo_3$ Total (ppm)	Hardness as $CaCo_3$ Noncarbonate (ppm)
Glacial Outwash Deposits	7.3	726	1.8	99	31	380	81	--	7.0	456	387	75
Cuyahoga Formation	7.3	728	0.6	90	38	416	71	--	3.4	438	380	64
Berea Sandstone	6.8	756	1.2	82	35	316	122	Slight	14.3	478	349	104
Bedford-Ohio Shales	7.3	1,653	0.4	136	61	531	472	--	40	1,177	590	286
Columbus Limestone	7.3	1,580	1.6	227	80	399	600	4.0	39	1,249	902	577
Columbus-Rasin River Limestones	7.3	1,859	0.7	291	98	346	838	17.0	47	1,555	1,129	855

Source: Bulletin 30, Ohio Department of Natural Resources as cited in CH2M-Hill, 1984.

of AF Plant 85 (CH2M-Hill, 1984); but little is known about the quality of water produced from these wells, or their impact on groundwater flow at or near the base. Since little is known about these wells, it is impossible to postulate the impact that Base activities might be having on them.

The former Nelson Road Municipal Well Field and Water Treatment Plant was located near Alum Creek about one mile west of AF Plant 85. The City of Columbus stopped using the Nelson Road plant in the early 1970s because of declining water quality. At the time of the Nelson Road plant shut-down, the water had a hardness of 500 to 1,000 ppm. The four municipal wells have not been abandoned and may potentially be used as an alternative supply of water in the future.

The existing municipal well field, used to supplement surface water supplies, is located in south Columbus more than 10 miles from AF Plant 85, and is developed in the glacial outwash deposits near the confluence of the Scioto River and Big Walnut Creek.

3.4 CLIMATOLOGY/AIR

3.4.1 Climatology/Meteorology

The climate at AF Plant 85 and the City of Columbus is, for the most part, temperate. Changeable weather conditions are brought about by air masses from various directions. Cool air masses, frequently from central and northwestern Canada, and occasionally from the Hudson Bay Region during spring,affect this region. In summer, tropical Gulf masses reach Columbus. The general circulation sometimes brings showers or snow from the Atlantic.

Temperature and precipitation data for the region are summarized in Table 3.4-1. December, January and February have the lowest normal minimum temperatures; between 20 and 23^{O}F. June, July and August have the highest normal maximum temperatures; between 82 and 85^{O}F. The average date of the first freeze in the fall is October 31, and the average date of the last freezing temperature in the spring is April 16. However, there are wide local variations.

Columbus does not have a "wet" or "dry" season. Average precipitation is generally greater in the spring and early summer than in the

TABLE 3.4-1. METEOROLOGICAL DATA SUMMARY FOR COLUMBUS, OHIO

	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.	Ann.
<u>Temperature</u>(^{o}F)													
Record High	74	73	85	89	94	102	100	100	100	90	80	76	102
Record Low	-19	-13	-2	14	25	35	43	39	31	20	5	-10	-19
Normal Maximum	36.4	39.2	49.3	62.8	72.9	81.9	84.8	83.7	77.6	66.4	50.9	38.7	62.1
Normal Minimum	20.4	21.4	29.1	39.5	49.3	58.9	62.4	60.1	52.7	42.0	32.4	22.7	40.9
Normal Mean	28.4	30.3	39.2	51.2	61.1	70.4	73.6	71.9	65.2	54.2	41.7	30.7	51.5
<u>Precipitation (inches)</u>													
Record Maximum (in 24 hours)	4.81	2.15	3.40	2.37	2.72	2.93	3.82	3.79	4.86	1.87	2.05	1.74	4.86
Normal Mean	2.87	2.32	3.44	3.71	4.10	4.13	4.21	2.86	2.41	1.89	2.68	2.39	37.01
Mean Snowfall	8.7	6.0	4.6	0.8	Trace	0.0	0.0	0.0	Trace	Trace	2.7	5.6	28.4

Period: 1939-1982
Source: United States Department of Commerce, National Climatic Data Center as cited in CH2M-Hill, 1986.

fall. The average precipitation is about 37 inches per year and the average snowfall is about 28 inches per year. Thunderstorms occur on an average of 42 days each year, mostly in the summer. Mean annual lake evaporation, commonly used to estimate the mean annual evapotranspiration rate, is about 33 inches per year. The difference between the mean annual precipitation and the mean annual evapotranspiration gives an annual net precipitation of 4 inches per year.

The prevailing wind is from the south-southwest. Wind speed ranges on a monthly average between 7 and 10 miles per hour. The rolling landscape is conducive to air drainage at speeds generally less than 4 miles per hour.

3.4.2 Air Quality

Air quality in the Columbus area is generally good. Estimates of air quality are based on the levels of the following criteria pollutants: ozone, carbon monoxide, nitrous oxide, lead, sulfur dioxide and total suspended particulates (TSP). If their levels are below the Federal standards, these pollutants are designated "attainment"; if levels exceed Federal standards they are designated "non-attainment". The Ohio EPA has a current official designation of "attainment" on all these pollutants except carbon monoxide and TSP. Carbon monoxide level is below the standard, and an official "attainment" designation is awaited. TSP is classified as "secondary non-attainment" which implies that this pollutant is a nuisance, although not a health hazard. The Pollution Standard Index (PSI) for the Columbus area is mainly based on TSP or ozone, whichever is higher. The PSI varies from 0 (no pollutant) to 100 (air quality standard level). Ozone in Columbus sometimes reaches a PSI of 60 to 70 in summer. However, neither ozone nor TSP has reached 100 in the last few years.

3.5 HUMAN ENVIRONMENT

3.5.1 Population

The population distributions for Gahanna, the City of Columbus, and the Columbus Metropolitan Area are given in Table 3.5-1. The Columbus Metropolitan area includes Delaware, Fairfield, Madison, Pickaway, and Franklin

TABLE 3.5-1. CENSUS DATA FOR THE COLUMBUS AREA

	1980	1987
Columbus	564,871	581,808
Columbus Metropolitan Area	1,093,316	1,143,869
Gahanna	18,001	19,881

Counties. In addition to the City of Columbus, ten other cities and villages lie wholly or partially in Franklin County. The four located in the vicinity of AF Plant 85 are Bexley, Gahanna, Reynoldsburg, and Whitehall.

3.5.2 Demographics

A profile of the demographic characteristics of the residents of Columbus and Franklin County has the distribution given in Table 3.5-2.

3.5.3 Land Use

The area around AF Plant 85 is primarily urban. Franklin County is one of the most highly urbanized counties in Ohio. Nonurbanized land and farmland is located mainly in the western and southern portions of the county. AF Plant 85, which is adjacent to the Port Columbus International Airport, is surrounded by industrial, commercial, and residential zoning areas. The area to the south of the airport is primarily industrial, and includes AF Plant 85 and the Defense Construction Supply Center. Areas west of the airport are commercial and residential with some vacant space which serves as a buffer to the airport. The Ohio Division of Natural Areas and Preserves identified four natural areas within 4 miles of the plant:

1. A one-mile stretch of Big Walnut Creek located south of Morse Road, approximately one mile north of Gahanna and approximately 4 miles north (upstream) from AF Plant 85.
2. A 2,000-foot stretch of Big Walnut Creek in Gahanna, approximately one mile northeast of AF Plant 85.
3. The Gahanna Woods Natural Preserve, approximately 3 miles northeast of AF Plant 85, owned by the Ohio Department of Natural Resources and managed by the City of Gahanna Parks. This comprises over 50 acres of four different habitats.
4. A smaller 6-acre area of land immediately south of Gahanna Woods, about 2.5 miles northeast of AF Plant 85.

TABLE 3.5-2 DEMOGRAPHIC PROFILE OF CITY OF COLUMBUS AND FRANKLIN COUNTY RESIDENTS[a]

	City of Columbus	Franklin County
1. Age	Median age is 27.3 years; 65.3% of the population is between the ages of 17 and 65.	Median age is 28.2 years; 64.1% of the population is between the ages of 17 and 65.
2. Household Size	2.49 persons/household	2.61 persons/household
3. Race	76.50% white 22.07% black	83.68% white 15.05% black
4. Income	Median income is \$14,834. Per capita income is \$6,183 and 12.1% of families are below poverty level.	Median income is \$17,081. Per capita income is \$7,591 and 8.9% of families are below poverty level.

[a] From U.S. Department of Commerce, County and City Data Book, 1983.

4.0 BASIS FOR PROGRAM APPROACH

4.1 PHYSIOCHEMICAL PROPERTIES OF THE CONTAMINANTS

Sampling conducted during the Phase II Stage 1 IRP investigation resulted in the reporting of 12 contaminants identified at 5 locations at AF Plant 85. The physiochemical properties of these compounds are discussed in the following sections. These properties may be used to estimate the possible environmental transport and fate of each compound.

Manganese. Manganese was detected above the SDWS in groundwater collected from Well PG-201, located next to the Coal Pile (Site 2). Manganese concentrations in soil range from 20 to 3000 mg/kg, though 600 mg/kg is average. The most common forms of manganese are the divalent cations (Mn^{2+}) which are soluble, mobile, and available. Under reducing conditions found in water-saturated soils, Mn^{2+} is stable and strongly adsorbed onto clay or organic particles (EPA, 1983).

Lead. Lead was detected in sediment samples collected along Mason's Run (Site 5). Lead is strongly adsorbed to soil and is readily retained in soil by precipitation of various lead compounds. Adsorption of lead is a major process controlling transport and is influenced by soil type, complex formation, and pH. Lead mobility is reduced by the formation of organic metal complexes and chelates with humus and by reactions with clays, sulfates, carbonates, hydroxides, and sesquioxides which make lead less soluble. At a pH greater than 6, lead is either adsorbed by clay particles or forms lead carbonate. Movement of lead from soil into biota, water, or air occurs to a limited degree in the terrestrial environment. In the aquatic environment, bioaccumulation in aquatic species occurs readily (Battelle, 1986).

Chromium. Chromium was detected in sediment samples collected along Mason's Run (Site 5). Chromium concentrations range from 1 to 1000 mg/kg in native soils, with an average concentration of 100 mg/kg (EPA, 1983). Chromium exists in two oxidation states in aqueous environments: Cr(III) and Cr(VI), although valence states may range from -2 to +6. Cr(IV) is weakly absorbed to inorganic materials while Cr(III) is more easily adsorbed by organic materials. Chromium, although an essential nutrient, may be accumulated in aquatic biota. Levels in biota are typically lower than levels detected in sediment (Callahan et al., 1979). Chromium reacts with dilute acids such as HCl and H_2SO_4, but not HNO_3 (Merck, 1983).

Polychlorinated biphenyls (PCBs). PCBs above the TSCA action level of 50 mg/kg were detected in soil samples collected from the PCB Spill Site (Site 3). PCBs have a very low solubility in water, ranging from 0.91 to 0.0027 mg/l and decreasing with increasing chlorination (Callahan et al., 1979). These compounds are more soluble in solvents such as alcohol, ether, acetone, and benzene (Merck, 1983). PCBs also adsorb readily to sediment and soil. The soil adsorption coefficient (K_{ow}) ranges from ~10^5 TO ~10^9, increasing with increased chlorination (A. D. Little, 1987). Physical properties of PCBs include densities ranging from 1.15 to 1.58 gm/cm^3, and boiling points ranging from 340^o to 375^{o}C (Sax, 1979).

Toluene. Toluene was detected in soil samples collected from the Fire Department Training Area (Site 4) and the James Road Hazardous Waste Storage Pad (Site 8). Toluene is slightly soluble in water. It has been reported that toluene in groundwater at an initial concentration of 2.22 ug/l in the presence of other components of high octane gasoline (100 ul/l) will biodegrade 100% after 192 hours at 13^{o}C (Verschueren, 1983). The evaporative half-life from water at a depth of 1 meter at 25^{o}C is 5.18 hours (Verschueren, 1983). Physical properties of toluene include a melting point of -95^{o}C, a boiling point of 111^{o}C, and density of 0.87 g/cm^3 (Sax, 1979).

Methylene Chloride (MeCl). MeCl was detected in soil samples collected at the Fire Department Training Area (Site 4). MeCl is soluble in water at 200,000 mg/l at 20^{o}C. The evaporative half-life at a depth of 6.5 cm in water at 25^{o}C is 18.4 to 25.2 minutes, indicating that volatilization may be a major fate process. The soil adsorption coefficient (K_{ow}) is approximately 18.2, indicating that MeCl does not readily adsorb to soil particles (Verschueren, 1983). MeCl is not highly lipophilic, thus limiting bioaccumulation in aquatic organisms. The physical properties of MeCl include a melting point of -95^{o}C, a boiling point of 40^{o}C, and a density of 1.33 g/cm^3 (Merck, 1983).

Trichloroethene (TCE). Trichloroethene was detected in soils collected at the Fire Department Training Area (Site 4). Trichloroethene is slightly soluble in water, with a solubility of 1,100 mg/l at 20^{o}C. Trichloroethene is miscible with ether, alcohol, and chloroform. The soil adsorption coefficient (K_{ow}) is 263, indicating that trichloroethene will slightly adsorb onto soil particles (Verschueren, 1983). TCE has a relatively high vapor pressure and will quickly volatilize and move into the atmosphere from aquatic systems. Physical properties of trichloroethene include a melting point of -73°C, a boiling point of 87°C, and density of 1.45 g/cm^3. Vapor density is 4.53 (air = 1.00) (Merck, 1983).

1,1,1-trichloroethane - 1,1,1-Trichloroethane was detected in soil samples collected at the Fire Department Training Area (Site 4) and the James Road Hazardous Waste Storage Pad (Site 8). 1,1,1-Trichloroethane has a low vapor pressure of 96 torr at 20°C. The volatilization half-life has been reported for a 1 mg/l solution at 20 ± 3 minutes when aerated in an open container at 25°C. With an octanol/water partition coefficient of 2.17, 1,1,1-trichloroethane may be adsorped onto clay particles or organic matter. Bioaccumulation in aquatic organisms may also occur (Callahan, et al., 1979). Physical properties of 1,1,1-trichloroethane include a melting point of -30.41°C and a boiling point of 74.1°C at 760 torr (EPA, 1983).

Dichloroethane (DCE). DCE was detected in soil collected at the Fire Department Training Area (Site 4) and the James Road Hazardous Waste Storage Pad (Site 8). DCE is very soluble in water, with a solubility of 13.2 to 20.0 mg/l at 25°C. Because DCE is not highly lipophilic, bioaccumulation in aquatic organisms is unlikely. Volatilization into the atmosphere is the major transport process from aquatic systems. In the atmosphere, DCE is readily degraded by oxidation (Callahan et al., 1979). The soil adsorption coefficient (K_{OW}) is 30, indicating the DCE does not readily adsorb onto soil particles (Verschueren, 1983). DCE has a boiling point of 83°C, a melting point of -35°C, and density of 1.25 g/cm^3. DCE is miscible with alcohol, chloroform, and ether (Merck, 1983).

Trichlorotrifluoroethane (Freon 113). Freon 113 was detected in groundwater samples collected at the James Road Hazardous Waste Storage Pad (Site 8). Freon 113 is soluble in alcohol, benzene, and ether. It has a melting point of 13.2°C, a boiling point of 46°C, and density of 1.57 g/cm^3 (Sax, 1979).

Sulfate. Sulfate was detected in groundwater samples collected near Mason's Run (Site 5) at concentrations higher than the SDWS. Dissolved sulfate may degrade and be released to the atmosphere as hydrogen sulfide, be incorporated in organic matter (National Academy of Sciences, 1977), or it may precipitate as barium or calcium sulfate if it comes in contact with either of these ions.

Total Organic Halogens (TOX). TOX was detected in groundwater samples collected near the James Road Hazardous Waste Storage Pad (Site 8).

TOX is used as an indicator for the presence of brominated, chlorinated and/or fluorinated compounds.

4.2 SOURCES, PATHWAYS, AND RECEPTORS

There are five sites at AF Plant 85 that have been designated as sources that may release contaminants to the environment. In order to assess the impact of each of these sites on the environment and human health, potential pathways of physical migration and contaminant receptors have been identified and are shown in Table 4.2-1. The matrix illustrates possible interfaces that may occur from the source via physical migration pathways to the receptors. These relationships may indicate the potential link between on-site contamination and offsite receptors.

4.2.1 On-Site Pathways

4.2.1.1 Mason's Run

Mason's Run is located in the central plant area, entering from the Port Columbus International Airport and flowing south until joining Big Walnut Creek about 5 miles south of the plant. Two potential sources of contaminants are in close proximity to Mason's Run. These sites are the PCB Spill Area and the Coal Pile (Site 2). Each site has reported surface contamination and could contribute contamination via surface runoff into Mason's Run. Groundwater, which feeds Mason's Run, may also contribute to surface water quality.

4.2.1.2 Turkey Run

Turkey Run is located in the western portion of the plant, also entering from Port Columbus International Airport and flowing south, eventually joining Big Walnut Creek. Although potential sources of contamination at AF Plant 85 are not in proximity to Turkey Run, surface drainage indicates that contaminants could migrate to Turkey Run, especially during rainstorm events.

TABLE 4.2-1. POTENTIAL EXPOSURE PATHWAYS TO OFFSITE ENVIRONMENTAL RECEPTORS

Potential Sources					On Site Pathways	Offsite Pathways (Environmental Receptors)			
Coal Pile	PCB Spill	Fire Department Training Area	Mason's Run	James Road NW Pad		Big Walnut Creek	Regional Aquifer	Flora and Fauna	Atmosphere
●	●				Mason's Run	●	●	●	
		●		●	Turkey Run	●	●	●	
●	●	●		●	Surface Runoff/Subdrains	●		●	
●		●	●	●	Ground-Water	●	●	●	
●	●	●	●	●	Surface Soils	●	●		●
	●	●		●	Subsurface Soils		●		

4.2.1.3 Surface Runoff and Subdrains

An extensive stormwater drainage system has been constructed throughout the main plant area, which discharges to Mason's Run at the plant entrance gate. Miscellaneous fuel spills and oily discharges to Mason's Run have been reported in the past which resulted in the construction of an oil skimmer system near the entrance gate.

4.2.1.4 Groundwater Below AF Plant 85

The principal groundwater aquifer at AF Plant 85 is in the glacial deposits overlying impermeable shale. For the most part, recharge to this aquifer occurs through infiltration from creeks during the spring, including Mason's Run, Turkey Run, Alum Creek, and Big Walnut Creek. Minor recharge also occurs as direct infiltration of precipitation through the glacial deposits. Groundwater discharges chiefly to major streams during the fall. Hence, the water table usually declines persistently throughout the summer, reaching its lowest stage in the fall and its highest stage in the early spring.

4.2.1.5 Surface Soils

The surface soils at AF Plant 85 are poorly drained, with relatively high potential for spilled contaminants, such as fuel, waste oils and PCBs, to migrate via surface runoff during rainstorm events.

4.2.1.6 Subsurface Soils

The contamination of subsurface soils may result from past waste handling spills or surface water transport along drainageways to low areas within AF Plant 85. Although subsurface contamination is expected to be variable, it is most likely to occur near past spill or waste storage areas.

4.2.2 Off-Site Receptors

4.2.2.1 Big Walnut Creek

Both Mason's Run and Turkey Run flow into Big Walnut Creek approximately 5 miles south of AF Plant 85. This waterway represents both a potential environmental pathway and an environmental receptor. Contaminants that drain into Mason's Run ultimately may reach Big Walnut Creek, where impacts on aquatic biota and exposure to humans may be possible.

Big Walnut Creek is also a potential pathway of contaminant transport to the regional aquifer. Recharge to this aquifer occurs through infiltration from Mason's Run, Turkey Run, Alum Creek, and Big Walnut Creek.

4.2.2.2 Regional Aquifer

The regional groundwater aquifer provides a potential pathway for receptors downgradient of AF Plant 85 but also is a receptor receiving contaminants from other sources. As a receptor, the introduction of contaminants results in the degradation of the groundwater as a natural resource and its usability by humans if established groundwater quality standards are exceeded. A discussion of groundwater use is presented in Section 3.3.3.2.

4.2.2.3 Flora and Fauna

The flora and fauna of AF Plant 85 are typical of those occurring in any urban industrialized site in the Columbus area and represent potential pathways and receptors of contaminants. The Ohio Department of Natural Areas and Preserves has identified three threatened or endangered species that are found within 3 miles of AF Plant 85. Also, the Gahanna Woods Natural Preserve is within 3 miles of the plant.

4.2.2.4 Atmosphere

The potential for airborne contaminated particulate and gaseous emissions from sites at AF Plant 85 appears limited under present plant conditions. Fugitive emissions could occur only when contaminated soils are disturbed during soil coring investigations or soil excavations during site remediation. Emissions will be minimized by utilizing real-time air monitoring during each of these activities.

4.2.3 Potential Exposure Pathways to Humans

Three pathways of exposure to human receptors have been identified and are shown in Table 4.2-2. Each exposure route is discussed in the following sections.

4.2.3.1 Dermal Contact

Dermal route of exposure is associated primarily with direct contact with contaminated soils, sediments, and surface waters offsite. This occurrence is not currently considered a public health issue. A comprehensive risk assessment will provide further evidence to determine the impact of dermal contact on human receptors.

4.2.3.2 Ingestion

Potential health impacts from ingestion of contaminated materials may come from the following sources:

- The ingestion of groundwater
- The ingestion of fish collected from Mason's Run, Turkey Run, Big Walnut Creek, or Alum Creek
- The hunting and ingestion of game animals.

A risk assessment will provide evidence regarding the impact of ingestion of potentially contaminated materials by human receptors.

TABLE 4.2-2. POTENTIAL EXPOSURE PATHWAYS TO HUMAN RECEPTORS

Offsite Pathways				
Big Walnut Creek	Regional Aquifer	Flora and Fauna	Atmosphere	Potential Exposure to Human Receptors
●	●		●	Dermal Contact
●	●	●		Ingestion
			●	Inhalation

4.2.3.3 Inhalation

Releases of contaminated particulate or gaseous emissions at AF Plant 85 are not likely to occur. Emissions from the designated sites could occur when contaminated surface soils are disturbed during field investigations and/or remediation. Battelle and any site subcontractors will have sufficient safety equipment of adequate quality and level (Level C and modified Level D) to protect personnel during site activities. Safety procedures to be used in the field investigations are described in the Health and Safety Plan prepared by Battelle.

4.3 ENVIRONMENTAL/HEALTH EFFECTS

Inorganic and organic chemicals were identified in the water, soil, and sediment during Phase II Stage 1 testing at AF Plant 85. Many of these chemicals may impact the health of living organisms and their environment. Tables 4.3-1, 4.3-2, and 4.3-3 provide summary lists of the chemicals found at the plant, the media in which they were identified, and associated aquatic, animal, and human health data. Potential health and environmental adverse effects of the compounds detected at AF Plant 85 are dependent upon their access to and transport along pathways to human and environmental receptors.

Manganese. The maximum manganese level (0.113 mg/l) found in groundwater at AF Plant 85 is in excess of the Secondary Drinking Water Standard (SDWS) of 0.05 mg/l. The SDWS is a nonenforceable recommended criterion for delivery of water by a public water system. The manganese SDWS is based on aesthetic, rather than health related criteria.

The effects of manganese are dependent upon the salt form in which it occurs. Manganese is the least toxic of the essential trace elements. Many animals can tolerate high intakes of manganese, up to several hundred thousand parts per million. Exposure to manganese by ingestion is not typical (Gosselin et al., 1984). Human exposure usually results from inhalation of dust or fumes (Windholz et al., 1983).

TABLE 4.3-1. CHEMICALS IDENTIFIED AT AF PLANT 85 WITH ASSOCIATED AQUATIC, ANIMAL AND HUMAN HEALTH DATA

Chemical	Media	Highest Concentration in Media	Freshwater Acute/ LOEL[a] (ug/l)	Freshwater Chronic/ LOEL (ug/l)	Safe Water and Fish Ingestion Level for Human Health (per l)	Safe Fish Ingestion Level for Human Health (per l)	Drinking Water MCL[b] (mg/l)
Manganese	Ground-water	0.113 mg/l	NSA	NSA	50 ug	100 ug	0.05
Sulfate	Ground-water	556 mg/l	NSA	NSA	NSA	NSA	NSA
Trichlorotri-fluoroethane (Freon 113)	Ground-water	NSA[c]	NSA	NSA	NSA	NSA	NSA
Total dissolved solids	Surface water	1,162 mg/l	NSA	NSA	250 mg	NSA	NSA
PCBs	Soil	422 ug/g	2.0	0.014	0.079 ng[d]	0.079 ng[d]	NSA
Toluene	Soil	140 ug/kg	17,500	NSA	14.3 mg	424 mg	NSA
Methylene chloride	Soil	180 ug/kg	NSA	NSA	NSA	NSA	NSA

TABLE 4.3-1. CHEMICALS IDENTIFIED AT AF PLANT 85 WITH ASSOCIATED AQUATIC, ANIMAL AND HUMAN HEALTH DATA (Continued)

Chemical	Media	Highest Concentration in Media	Freshwater Acute/ LOEL[a] (ug/l)	Freshwater Chronic/ LOEL (ug/l)	Safe Water and Fish Ingestion Level for Human Health (per l)	Safe Fish Ingestion Level for Human Health (per l)	Drinking Water MCL[b] (mg/l)
Trichloroethane	Soil	160,000 ug/kg	NSA	NSA	NSA	NSA	NSA
(1,1,1-isomer)			NSA	NSA	18.4 mg	1.03 g	NSA
(1,1,2-isomer)			NSA	NSA	0.6 ug[d]	41.8 ug[d]	NSA
Dichloroethane	Soil	980, 1,900 ug/kg	NSA	NSA	NSA	NSA	NSA
(1,2-isomer)			118,000[e]	20,000[e]	0.94 ug[d]	243 ug[e]	NSA
Trichloroethene	Soil	160,000 ug/kg	45,000	21,900	2.7 ug	80.7 ug	NSA
Oil/Grease (Hydrocarbons)	Soil	145, 180 ug/g					
	Sediment	2,360 ug/g	NSA	NSA	NSA	NSA	NSA
Lead	Sediment	95.3 ug/g	82[f]	3.2[f]	50 ug	NSA	0.05
Chromium	Sediment	62.2 ug/g	NSA	NSA	NSA	NSA	NSA
(Hexavalent)			16.0	11.0	50 ug	NSA	NSA
(Trivalent)			1,700[f]	210.0[f]	170 ug	3,433 mg	0.05

TABLE 4.3-1. CHEMICALS IDENTIFIED AT AF PLANT 85 WITH ASSOCIATED AQUATIC, ANIMAL AND HUMAN HEALTH DATA (Continued)

Chemical	Media	Highest Concentration in Media	Freshwater Acute/ LOEL[a] (ug/l)	Freshwater Chronic/ LOEL (ug/l)	Safe Water and Fish Ingestion Level for Human Health (per l)	Safe Fish Ingestion Level for Human Health (per l)	Drinking Water MCL[b] (mg/l)
Cadmium	Sediment		3.9[f]	1.1[f]	10 ug	NSA	0.01
Nickel	Sediment		1,800[f]	96[f]	13.4 ug	100 ug	NSA

* Source: USEPA, 1986
(a) LOEL = Lowest Observed Effects Level
(b) MCL = Maximum Contaminant Level
(c) NSA = No Standard Available
(d) Human Health Criteria Reported for Carcinogens at 10^{-6} Risk Level
(e) Criteria based on LOEL
(f) Hardness dependent critiera (100 mg/l used)

TABLE 4.3-2. SELECTED MAMMALIAN/AQUATIC TOXICITY VALUES FOR CHEMICALS AT AF PLANT 85*

Chemical	Rat Oral LD_{50}[a] (mg/kg)	Rat Inh LC_{LO}[b] (ppm)	Aquatic LC_{50}[c] (mg/l)
Trichlorotri-fluoroethane (Freon 113)	0.043	87,000	
PCBs	1,315		0.0013 (Daphnia magna)
Toluene	5,000	4,000	7.3 (Bass)
Methylene chloride	2,136	88,000 (LC_{50})	
Trichloroethane			
(1,1,1-isomer)	10,300	1,000	52.8 (Fathead minnow)
(1,1,2-isomer)	580	500	94 (Guppy)
Trichloroethene	7,193	8,000	
Dichloroethane			
(1,2-isomer)	770	1,000	202 (Guppy)
Cadmium	225		

* Source: Lewis & Tatken, 1986; Verschueren, 1983

(a) LD_{50} = Lethal dose for 50 percent of sample.

(b) LC_{LO} = Lowest dose lethal concentration.

(c) LC_{50} = Lethal concentration for 50 percent of sample.

TABLE 4.3-3. AIR EXPOSURE LIMITS AND CARCINOGENICITY AND HAZARD STATUS OF CHEMCIALS AT AF PLANT 85

Chemical	IDLH[a] Level (ppm)	PEL/TWA[b]	Carcinogen	Priority Toxic Pollutant	Hazardous Substance	Hazardous Waste Constituent
Manganese	10,000	5 mg/m^3				
Trichloro-trifluoro-ethane	4,500	7,600 mg/m^3				
PCBs	5-10 mg/m^3	0.5-1.0 mg/m^3	X	X	X	X
Toluene	2,000	200/100 ppm		X	X	X
Methylene Chloride	5,000	500/75 ppm		X	X	
Trichloro-ethane						
(1,1,1 -isomer)	1,000	350 ppm		X		X
(1,1,2- -isomer)	500	10 ppm	X	X		X
Dichloro-ethane	4,000	100 ppm	X	X		X

TABLE 4.3-3. AIR EXPOSURE LIMITS AND CARCINOGENICITY AND HAZARD STATUS OF CHEMCIALS AT AF PLANT 85* (Continued)

Chemical	IDLH[a] Level (ppm)	PEL/TWA[b]	Carcinogen	Priority Toxic Pollutant	Hazardous Substance	Hazardous Waste Constituent
Trichloro-ethene	1,000	100 ppm	X	X	X	X
Lead		0.2/0.15 mg/m^3	X	X	X	X
Chromium	30-250 mg/m^3	0.5-1.0 mg/m^3	X	X	X	X
Cadmium		0.1/0.04 mg/m^3	X	X	X	X
Nickel		1/0.015 mg/m^3	X	X	X	X

Source: Sittig, 1981

(a) Air concentration immediately dangerous to life or health.

(b) Permissible exposure limit (Federal standard)/NIOSH-acceptable time-weighted average concentration.

Acute systemic intoxication rarely occurs following oral ingestion of manganese. The inorganic salts are poorly absorbed through the lung or gastrointestinal tract. However, chronic manganese ingestion at low concentrations can lead to accumulation of toxic levels in critical organs (Gosselin et al., 1984).

Manganese is potentially toxic to plants irrigated with water containing high levels and in combination with soil at pH > 6. A criterion value of 200 ug/l has been suggested for consideration where acidophilic crops are cultivated or irrigated (USEPA, 1986).

Sulfates. The effects of sulfates are usually the result of the cation with which it is combined. Bronchoconstriction and susceptibility to infection have been noted in animals following inhalation of sulfates (Shriner et al., 1980). In water, sulfates are common inorganic anion components of dissolved solids. In conjunction with cations such as sodium or magnesium, sulfates may result in diarrhea. The maximum sulfate level (556 mg/l) found in groundwater at AF Plant 85 exceeds the SDWS of 250 mg/L recommended as protection against laxative effects (USEPA, 1986).

Trichlorotrifluoroethane. The Phase II Stage 1 analyses of groundwater detected the presence of 1,1,2-trichloro-1,1,2-trifluoroethane (Freon 113). Data concerning the effects of trichlorotrifluoroethane are limited. Exposure routes include ingestion, and skin and eye contact, though inhalation is the most typical exposure route. Trichlorotrifluoroethane may cause throat irritation, dermatitis, and drowsiness (Sittig, 1981). In humans, no effects occurred from inhalation of 1,000 mg/kg, 6 hr/day for 5 days, and 1,500 mg/kg for 2.75 hours (Verschueren, 1983).

Total Dissolved Solids (TDS). Total dissolved solids are comprised of a variety of chemical compounds, including organic salts and small amounts of organic matter. TDS levels of 1,162 mg/L found in groundwater and 678 mg/L measured in surface water at AF Plant 85 are in excess of the SDWS of 500 mg/L. High TDS levels are objectionable in drinking water due to their possible physiologic effects, their unpalatable mineral taste, and their corrosive activity. Depending upon their anion and cation composition, TDS levels may cause laxative effects, or adverse effects in individuals with cardiac disease, in pregnant women with toxemia, or in those on sodium-restricted diets (USEPA, 1986).

Increased water salinity, as a result of the chemical components of TDS levels, and TDS-related salinity changes have caused fish kills. Toxic levels of TDS constituents may result in the elimination of desirable food plants in natural habitats (USEPA, 1986).

Polychlorinated Biphenyls (PCBs). PCBs (as Arochlor 1260) were found in the soil at AF Plant 85 at a concentration of 422 ug/g. Exposure routes which may result in adverse effects include oral ingestion, skin absorption, and inhalation. In humans, toxic effects include chloracne and other dermal irritations, hepatotoxicity, and gastrointestinal disturbances (Clayton and Clayton, 1981).

Although the acute oral toxicity of PCBs is low, they can be absorbed from the gastrointestinal tract and stored in adipose tissue (Gosselin et al., 1984). These substances are considered to be animal carcinogens (NTP, 1985) causing liver tumors in mice and rats. PCBs may also be embryotoxic, causing stillbirth and birth defects (Sittig, 1981).

Toluene. Toluene was identified in the soil at AF Plant 85 at a maximum concentration of 140 ug/kg. The most common intoxication route for toluene is through inhalation, which can lead to lung aspiration problems (Clayton and Clayton, 1981). Skin irritation may result from dermal exposure. Toluene may also cause central nervous system depression (Sittig, 1981).

Methylene Chloride. Methylene chloride was found in the soil at AF Plant 85 at a concentration of 180 ug/kg. Available data indicate that in mammals, toxic effects are seen primarily at relatively high concentrations (Verschueren, 1983). Dermal exposure is mildly irritating and dermatitis may result. Methylene chloride may produce central nervous system depression when administered at high concentrations, especially through inhalation exposure (Gosselin et al., 1984).

1,1,1-Trichloroethane. A maximum level of 160,000 ug/kg of trichloroethane was found in the soils at AF Plant 85. The primary exposure route for health effects is inhalation. Acute oral toxicity is minimal. Trichloroethane is rapidly absorbed in the lungs and gastrointestinal tract (Parmeggiani, 1983). Both 1,1,1- and 1,1,2-trichlorothane are characterized as irritating to the eyes, mucous membranes, and, at high concentrations, cause central nervous system depression (Windholz et al., 1983). Effects of oral ingestion occur at lower concentrations for 1,1,2-trichloroethane compared to 1,1,1-trichloroethane.

Dichloroethane. Dichloroethane was detected at 1,900 ug/kg in the soil at AF Plant 85. Primary exposure routes include skin absorption, inhalation, and ingestion. Oral administrations of dichloroethane have caused cancers in both mice and rats. In humans, inhalation may cause irritation of the respiratory tract and conjunctiva, narcosis, and abdominal cramps (Windholz et al., 1983). Oral ingestion may be hepatotoxic or nephrotoxic (Gosselin et al., 1984).

Trichloroethene. Trichloroethene was identified in soil at the Fire Department Training Area (Site 4). U.S. EPA standards indicate that the trichloroethene should not occur at any level in ambient water for the protection of human health against ingestion of contaminated water or aquatic organisms (USEPA, 1986). Trichloroethene is irritating to the eyes, nose, and throat in vapor form. Dermal and ocular exposure to the liquid are also irritating. Symptoms of central nervous system depression are the primary systemic effects (Sittig, 1981). Evidence of carcinogenicity in animals exists and USEPA's Carcinogen Assessment Group has classified trichloroethene as a B2 carcinogen.

Oil and Grease (Hydrocarbons). Oil and grease were found in both the soil (145 ug/g) and sediment (2,360 ug/g) at AF Plant 85. USEPA standards for domestic water call for the complete absence of oil and grease. Aquatic life recommendations include (1) 0.01 of the lowest continuous 96-hour LC_{50} for fresh water species, (2) levels at the lowest concentrations which cause effects in the biota in sediment, and (3) the complete absence of floating petroleum and nonpetroleum-derived oils in surface waters (USEPA, 1986).

Due to the fact that oil and grease ingestion is organoleptically undesirable, human effects from oral intake are not a major concern. Acute lethal and long-term, sublethal toxic effects are known to occur in aquatic organisms. Once incorporated into sediments, oil and grease may remain unchanged for long periods of time, eventually affecting the benthic community structures. Oil and grease contamination of water often result in the drowning of water fowl, fish kills, and asphyxiation of benthic life forms (USEPA, 1986).

Lead. Lead was detected at 95.3 ug/g in the sediment of Mason's Run (Site 5) at AF Plant 85. Lead exposure is poisonous and occurs largely through inhalation or oral ingestion. The metal accumulates in the tissues of humans and animals. Chronic exposure effects include hematological, neurological, and renal toxicity. Children are especially sensitive to toxic effects of lead, which may impair normal development. Acute exposure may result in permanent brain damage (Windholz et al., 1983). Toxic lethal doses in fish may range from less than 1 mg/kg to over 500 mg/kg depending upon the solubility and form of lead, pH, hardness, alkalinity and fish species tested. As water hardness increases, both acute and chronic effects are reduced in severity (USEPA, 1986).

Chromium. Chromium was found at a concentration of 62.2 ug/g in the sediment of Mason's Run (Site 5) at AF Plant 85. Exposure may occur through air, water, soil, or food. Health effects of chromium vary for different valence states. Trivalent chromium toxicity is dependent upon water hardness and is generally less toxic than hexavalent chromium (USEPA, 1986). Other chromium valence states (especially hexavalent chromium) are irritants to the skin, respiratory tract, and gastrointestinal tract (Windholz, et al., 1983). Sufficient evidence exists to demonstrate that chromium and chromium compounds are human and animal carcinogens (NTP, 1985).

Cadmium. A maximum level of 0.49 ug/g of cadmium was detected in the sediment of Mason's Run (Site 5) at AF Plant 85. Exposure occurs largely through oral ingestion or inhalation. Degenerative bone disease and gastrointestinal upsets occur as a result of ingestion. Inhalation of airborne cadmium has been associated with high blood pressure, arteriosclerotic disease, anemia, and damage to the lung, kidney, and bones (Epstein and Grundy, 1974). There is sufficient evidence to demonstrate the carcinogenicity of cadmium in animals. Aerosol exposure caused lung cancer in rats (NTP, 1985).

Nickel. Nickel was found in the sediment of Mason's Run (Site 5) at AF Plant 85 at a maximum concentration of 24.1 ug/g. Health effects may result from oral, inhalation, and dermal exposures to nickel. Dermatitis has been noted in sensitive individuals following skin exposures. Ingestion of nickel salts may result in nausea, vomiting, or diarrhea (Windholz et al., 1983). Nickel and certain nickel compounds have been determined to be carcinogens, especially following inhalation exposure (NTP, 1985). Nickel criteria values for the protection of aquatic life are dependent on water hardness (USEPA, 1986).

4.4 PRELIMINARY TECHNOLOGIES

The five sites investigated at AF Plant 85 were categorized as one site requiring no further action and four sites requiring additional investigative work. During the first phase of the Feasibility Study (FS) discussed in Section 5.2.3, potential treatment technologies and their associated containment or disposal requirements for the four sites will be evaluated; prescreening of alternative technologies for suitability will be accomplished; and technology and/or disposal combinations will be assembled into alternatives.

The range of treatment technologies will include alternatives that might eliminate the need for long-term management and monitoring at sites to alternatives involving different technologies to reduce toxicity, mobility, or volume of contaminated soil and/or groundwater. Treatment technology will be assessed in terms of risk reduction achieved through destruction or detoxification of hazardous substances versus protectiveness of human health and the environment through prevention of exposure. As mandated by SARA Section 121, the use of treatment technologies to achieve a permanent solution to the maximum extent practical must be met by all remedial alternatives selected in the FS.

Potentially applicable remedial technologies specified in the National Contingency Plan that will be factored into the evaluation process are listed in Table 4.4-1.

4.5 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

As part of the Feasibility Study, described in Section 5.2.3 of this plan, alternative remedial actions will be evaluated to assess the degree to which they attain or exceed applicable and relevant Federal and State public health and environmental standards. Applicable standards are those carried out pursuant to CERCLA Section 104 or 106 that specifically address a hazardous substance, contaminant, remedial action, or locational circumstances. Relevant standards are those that apply to circumstances sufficiently similar to goals of CERCLA in which their application would be appropriate at a specific site although not legally required. Two of the more significant requirements which can be applicable or relevant and appropriate to remedial actions involving soil and groundwater restoration are the attainment of Maximum Contaminant Level Goals (MCLGs) established under the Safe Drinking Water Act and water quality criteria of the Clean Water Act, and land disposal ban provisions under the Hazardous and Solid Waste Amendments.

Response actions that meet ARARs, as a general rule, are effective in preventing or minimizing the release and migration of contaminants and thereby reduce the risk to present and future public health or the environment. Identification of ARARs will be accomplished early in the Feasibility Study to provide a measure of how effectively remedial alternatives will protect human health and the environment. Limited waivers from ARARs are provided for in SARA Section 121 since it will not always be feasible to meet every ARAR in all cases. Specific Federal environmental laws potentially applicable to a remedial process for chemicals identified at AF Plant 85 are listed in Table 4.5-1.

TABLE 4.4-1. POTENTIAL REMEDIAL TECHNOLOGIES AT AF PLANT 85

Technology	APPLICATION/RESPONSE ACTION: Air Pollution Controls	Surface Water Controls	Leachate Ground-Water Controls	Gas Migration Controls	Excavation & Removal of Waste & Soil	Removal and Containment of Contaminated Sediments	Direct Waste Treatment
Capping/Surface Sealing	X	X	X	X	X		
Dust Control	X				X		
Grading		X			X		
Revegetation		X			X		
Diversion/Collection		X					
Subsurface Containment Barriers			X				
Groundwater Pumping			X				
Subsurface Drains			X				
Surface Water/Sediment Containment Barriers		X				X	

TABLE 4.4-1. POTENTIAL REMEDIAL TECHNOLOGIES AT AF PLANT 85 (continued)

Technology	APPLICATION/RESPONSE ACTION						
	Air Pollution Controls	Surface Water Controls	Leachate Ground-Water Controls	Gas Migration Controls	Excavation & Removal of Waste & Soil	Removal and Containment of Contaminated Sediments	Direct Waste Treatment
Streambank Stabilization/ Channelization		X					
Excavation/Removal					X		
Dredging						X	
Biological Treatment							X
Chemical Treatment							X
Physical Treatment							X
Solids Handling/ Treatment							X
Thermal Destruction (Incineration)							X

Source: USEPA, January 1987

TABLE 4.5-1. APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR CHEMICALS IDENTIFIED AT AF PLANT 85

Chemical	Safe Drinking Water Act, MCLs (mg/l unless otherwise noted)	Clean Air Act, NAAQS (ug/m^3)	Clean Water Act, Water Quality Criteria for Human Health -- Fish and Drinking Water	Clean Water Act, Water Quality Criteria for Human Health -- Adjusted for Drinking Water only [a]	Safe Drinking Water Act, Health Advisories (mg/l)		
					1-day	10-day	Chronic (longer term)
1,2-Dichloroethane	0.005		0 (0.94 ug/l)	0 (0.94 ug/l)		Insufficient data	
1,1,1-Trichloroethane	0.200		18.4 ug/l	19 mg/l			1.0
Chromium Cr+6	0.05		50 ug/l	50 ug/l			
Cr+3			170 mg/l	179 mg/l			
Hydrocarbons (non-methane)		160 (3-hour)[b/c]					
Lead	0.05	1.5 (90-day)	50 ug/l	50 ug/l			
Polychlorinated biphenyls (PCBs)			0 (0.079 ng/l)	0 (>12.6 ng/l)	0.125	0.0125	
Toluene			14.3 mg/l	15 mg/l	21.5	2.2	0.34
Trichloroethene	0.005		0 (2.7 ug/l)	(2.8 ug/l)	2.0	0.2	0.075

[a] These adjusted criteria, for drinking water ingestion only, were derived from published EPA Water Quality Criteria (45 FR 79318-79379, November 28, 1980) for combined fish and drinking water ingestion and for fish ingestion alone. These adjusted values are not official EPA Water Quality Criteria, but may be appropriate for Superfund sites with contaminated ground water. In the derivation of these values, intake was assumed to be 2 liters/day for drinking water and 6.5 grams/day for fish; human body weight was assumed to be 70 kilograms.

[b] Annual maximum concentration not to be exceeded more than once per year.

[c] As a guide in devising implementation plans for achieving oxidant standards.

Source: USEPA, June 1985b

4.6 DATA REQUIREMENTS

4.6.1 Data Quality Objectives (DQOs)

The development of data quality objectives will ensure that the level and extent of sampling and analysis to be conducted in the IRP Stage 2 are consistent with the data requirement needs to produce an adequate evaluation of remedial alternatives in the Feasibility Study (FS). A three-step approach to develop the DQOs is planned. The three-step approach consists of

- Initial identification of overall informational needs
- The development of a field program to satisfy any data needs remaining once existing information has been reviewed
- The selection of sampling and analytical methods to achieve the objectives of the field program.

Each step in the development of DQOs is discussed in the sections below.

4.6.1.1 Initial Evaluation

All available data collected during previous investigations at AF Plant 85 have been evaluated and informational needs to satisfy the requirements of the remedial investigation (RI) have been identified. These data were related to both investigative activities to be performed and the proposed remedial actions. Once the proposed remedial actions were identified, the types of information necessary to carry out the most cost-effective action for the FS were planned. Data types, such as technical, environmental, and health risk information, are required for the preparation of the AF Plant 85 RI/FS.

4.6.1.2 Sampling Plans

Further investigative activities are necessary to satisfy the informational needs to the RI/FS. To collect needed data, the development of a field data collection program was designed. Site investigations will include sampling at the following locations:

- Mason's Run (Site 5) - Water and sediment samples will be collected to determine if contamination is increasing in the creek as it crosses the plant and to determine if surface runoff has contaminated the creek downstream of the PCB Spill Site (Site 3).
- PCB Spill Site (Site 3) - Soil samples will be collected to delineate the extent of contamination.
- James Road Hazardous Waste Storage Pad (Site 8) - Monitoring wells will be installed.
- Fire Department Training Area (Site 4) - One monitoring well will be installed.
- Plant Perimeter Wells - Perimeter monitoring wells will be installed to determine if off-site migration of contaminants occurs at AF Plant 85.

No additional work is proposed for the Coal Pile (Site 2) since sampling and analysis indicate that only Secondary Drinking Water Standards are exceeded there and for only one constituent (manganese).

4.6.1.3 Sampling and Analysis

The final step of the DQOs was to select and document appropriate field and laboratory methodologies to be utilized for the collection, preservation, and handling of various types of samples from selected environmental media. Documentation of the appropriate field and laboratory methods for sampling at AF Plant 85 are discussed in the Quality Assurance Program Plan.

4.6.1.4 Sample Identification

For each sample collected at AF Plant 85 during the field investigation, a coding system will be used to identify pertinent information concerning each sample. The coding system will adhere to the basic OEHL procedure to determine sample identification codes as follows:

Sample Identification Code

Installation Code: The three-digit number used for the Plant 85 film dosimetry program with a zero prefix.

Sample Site Type (media): two-letter code to identify the source of the sample as follows:

Nonpotable groundwater	NG
Nonpotable surface water, source (effluent)	NS
Potable water, groundwater	PG
Soil (solid) (no monitoring well installed)	SO
Stream sediment	SS
Potable surface water	PS

Sample Location: A one-number code to identify the project site as follows:

Coal Pile	2
PCB site	3
Fire training area	4
Mason's Run	5
James Road storage pad	8

plus a sequential 3-number code by project site to differentiate between multiple identical media sample sites.

As an example:

0085-NS-5001 refers to a Plant 85 (0085) stream sampling (NS) station at Mason's Run (Site 5).

Samples collected (i.e., soil samples) for visual identification in the field will not be assigned a sample identification number. Descriptions will be maintained on appropriate logs by depth.

5.0 SCOPE OF WORK

5.1 ORGANIZATION OF EFFORT

The work effort of the IRP Stage 2 investigation at AF Plant No. 85 will be directed toward a more definitive identification of environmental problems at four specific sites. These sites were identified in the Stage 1 report as requiring further study, both as to the quantity and quality of contaminants found at these sites and as to the possibility of these contaminants migrating offsite either in surface water runoff or groundwater flow. A FONSI document will also be prepared for the Coal Pile (Site 2) which was identified as requiring no further action.

5.1.1 Operable Units

An operable unit is a discrete part of response actions to be evaluated in the Feasibility Study that decreases a release, threat of release, or pathway of exposure. The development and screening of remedial alternatives, discussed in Section 5.2.3.3, may include the separation of response actions into operable units in order to implement source control, management of migration and/or removal.

5.1.2 Combined Site Investigations

Combined site investigations are planned for field-related tasks, evaluation-related tasks, and Feasibility Study tasks described in Sections 5.2.1, 5.2.2, and 5.2.3, respectively. Due to the proximity of the Fire Department Training Area (Site 4) to the James Road Hazardous Waste Storage Pad (Site 8); and the PCB Spill Site (Site 3) to Mason's Run (Site 5); the results of field-related investigations will be combined in evaluations to produce consistent interpretations between the sites.

The evaluation-related tasks involve combining the field results from the four sites in order to perform plant-wide assessments and surveys. Development and screening of remedial alternatives in the Feasibility Study may result in the evaluation of potential technologies applicable at more than one site.

5.2 GENERAL DISCUSSION OF INTEGRATED IRP TASKS

The IRP Tasks associated with this Work Plan include field-related, evaluation-related, and feasibility study tasks.

In addition to the nine field-related tasks defined in the IRP Work Plan outline, three additional field tasks will be undertaken. These tasks were arrived at during a discussion between Battelle representatives and personnel of USAFOEHL/TS and AF Plant 85. These three tasks consist of stream water sampling at Mason's Run (Site 5), stream sediment sampling at Mason's Run (Site 5), and repairing and restoring existing wells.

5.2.1 Field Related Tasks

Ground transport will be used to mobilize the field team and equipment. All equipment will be packaged so as to prevent damage in transit and ensure successful field performance. These equipment and materials will include

- Field instrumentation and data acquisition equipment
- Safety equipment
- Materials and containers for soil and water samples
- Office materials.

The Battelle Field Team Leader will arrive on the site prior to the performance of any contracted work. The Field Team Leader will meet with the Base Engineer to plan initial work activities. Meetings will then be held with each task contractor prior to initiation of field work to arrange logistics, work schedule, safety procedures, and to address all questions and clarify project objectives.

AF Plant 85 will arrange for, and have available prior to the start-up of field work, the following services, materials, work space, and items of equipment to support Battelle:

1. Personnel identification badges and vehicle passes and/or entry permits.

2. A secure staging area for storage of equipment and supplies.

3. A supply (i.e., fire hydrant) for large quantities (up to a maximum of 1,000 gallons) of potable water to be used in equipment cleaning, etc.

4. A temporary office area, not to exceed 100 square feet and equipped with a Class A telephone for local and long distance phone calls. Battelle will pay for any long distance telephone calls made by its personnel from this phone.

Prior to any digging or drilling by Battelle, the Plant Engineer will locate underground utilities and issue digging permits. He or she will assign accumulation areas within the installation to which the contractor will deliver any hazardous drill cuttings/fluids generated from the required work. The Base Engineer will also take custody of these hazardous drill cuttings/fluids and properly dispose of the material according to applicable State and Federal regulations. Battelle will provide laboratory analysis of the drill cuttings contained in each barrel.

Decontamination consists of physically removing contaminants and/or changing their chemical nature to innocuous substances. The extent of the decontamination procedures is dependent on a number of factors, the most important being the type of contaminants involved; the more harmful the contaminant, the more extensive and thorough the decontamination must be.

All equipment will be cleaned prior to and after each use on this project. Decontamination will consist of combinations of steam cleaning and/or laboratory-grade detergent wash, drinking-quality water (ASTM Type II Reagent Water) rinse, pesticide-grade methanol rinse, and pesticide-grade hexane rinse. Procedures for equipment decontamination are discussed in Section 2.0 of the Quality Assurance Project Plan (QAPP).

The personnel decontamination procedures to be used at AF Plant 85 will be performed routinely at each drilling location or other sampling sites prior to personnel entering vehicles or leaving the study area. Particular attention will be given to articles of clothing which come in contact with samples and/or drilling equipment. Battelle and each subcontractor will provide all protective clothing for its own personnel, and the equipment necessary to comply with decontamination procedures specified in the Health and Safety Plan.

5.2.1.1 Soil Gas Surveys

No soil gas surveys are planned for this stage of work.

5.2.1.2 Geophysical Surveys

No geophysical surveys are planned for this stage of work. This Work Plan is not intended to include the extensive characterization provided by such surveys. The detection and assessment of contamination present at locations at the plant should be adequately assessed by the proposed borehole testing and sampling program. Although geophysical surveys (both surface-based and borehole) provide unique types of data, the basic data needed to develop a simple and accurate site assessment can be obtained by visually analyzing soil samples. Simple observations include assessment of soil or sediment type, porosity, grain size, and knowledge of spatial variability. These types of observations can be coupled with information that is gained while drilling and sampling (e.g., rate of fluid inflow into the borehole, rate of borehole advancement or drilling rate) and with general geologic experience including knowledge of typical "textbook" values for critical hydrogeologic parameters.

5.2.1.3 Subsurface Soil Surveys

Soil borings will be drilled at AF Plant 85 for installation of monitoring wells and/or defining the extent of soil contamination. All borings will be drilled using 6.25-inch O.D. hollow-stem augers. Split-spoon samples will be obtained using ASTM Method D-1586.

Soil borings will be drilled at the PCB Spill Site (Site 3) to a depth of 10 feet to define the extent of soil contamination. Sample collection will start at the 2.5-foot depth and continue to 11.5 feet with the collection of split-spoon samples at 2.5 foot intervals. PCB sampling will be conducted in accordance with the procedures described in the USEPA publication Verification of PCB Spill Cleanup by Sampling and Analysis (EPA 560/5-86-026). The samples will be submitted for chemical analysis.

Borings drilled for monitoring well installation (Section 5.2.1.5) will have split-spoon samples taken at 2.5-foot intervals for the first 10 feet and at 5-foot intervals for the remainder of the boring. Lithological/hydrogeological data will be obtained from the split-spoon samples and drill cuttings; however, no soil samples will be collected for chemical analysis.

The ambient air will be monitored during all soil boring work with a photoionization meter (HNU) or organic vapor analyzer (OVA) to identify the presence of potentially hazardous and/or toxic vapors or gases. Vapor levels of each sample will be recorded on the boring logs. Should soil encountered during borehole drilling appear to be abnormally discolored, have detectable odors, or have above background organic vapor levels, the soil will be placed in new, unused drums. The interval(s) from which suspected contaminated soil cuttings were collected will be recorded on the boring logs.

Borehole Logs and Documentation. Each borehole will be completely described on a stratigraphic borehole log as it is being drilled. The following information will be recorded on each borehole log:

1. Depths will be recorded in feet (to the nearest 0.1 foot).
2. Split-spoon samples from each interval will be logged by the Battelle hydrogeologist. All samples will be monitored with a HNU or OVA, and vapor levels will be recorded. Sample description will include unified soil classification (U.S. Army Corps of Engineers, 1953), color, odor, organic vapor (both ambient and interval levels), and secondary geotechnical information.
3. Lithologic boundaries will be recorded.
4. Depth to water will be measured and recorded after the water level has stabilized.
5. The start-up and completion dates will be included.
6. The type of drilling equipment will be recorded.
7. Any special problems encountered during the drilling procedure will be included on the log.

Decontamination Procedures. All tasks associated with soil boring will be subcontracted. Drilling equipment, including drill bits, will be steam cleaned prior to start-up and between locations to prevent the chance of cross contamination from one location to another. Drilling will proceed from the "least" to the "most" contaminated areas, if possible. A general subjective ranking according to degree of contamination is: 1) the plant perimeter wells (least contaminated); 2) Coal Pile Leachate Site; 3) Mason's Run; 4) James Road Hazardous Waste Storage Pad; 5) Fire Department Training Area; 6) PCB spill site (most contaminated).

Tools to be used for soil sampling include a split-spoon sampler, scoops, and sample-cutting knives. Decontamination will include wiping off visible particulate matter, washing with a laboratory-grade detergent in clean water, solvent (methanol) rinsing, and final rinsing with distilled water.

When necessary, the OVA will be decontaminated prior to continuing work, but not less than once per day. Decontamination of the injection port, column, and detector will consist of a purge of the equipment with carrier gas accompanied by a marked temperature elevation of the heating zone. Syringes will be decontaminated by rinsing with methanol, water, and finally with methanol again. All wash water or solvents used to decontaminate all sampling equipment will be collected and stored in 55-gallon drums and later disposed of at an approved site.

Borehole Sealing and Location. For those boreholes that will not be converted into monitoring wells, the borehole will be tremie-grouted with bentonite/cement grout and marked with a permanent marker. The exact location and elevation of each borehole will be determined by a professional surveyor and tied to plant coordinates located on a map.

5.2.1.4 Borehole Geophysical Surveys

No borehole geophysical surveys are planned for the new wells. Adequate differentiation of soil types can be made by visual analysis of samples and cuttings.

5.2.1.5 Monitoring Wells

Construction and Development. Monitoring well borings will be drilled using 6.25-inch O.D. hollow-stem augers. The 14 wells will be constructed of 2-inch schedule 40 PVC casing and well screen. Of the 14 wells to be installed, six will be screened in the Wisconsin Till. These shallow wells will be screened to intercept the water table in order to detect floating contaminants. The six shallow wells will have 10-foot screens with 5 to 8 feet of screen below the water table. The eight deeper wells will have 10-foot screens and be will set in the upper portion of the Illinoian Outwash. The screen slot size will be 0.010-inch (10 slot), but smaller sizes may be used based upon borehole geology. Well screens and casing will be flush threaded casing; no glue fittings will be used. The screen will be capped at the bottom. The use of PVC casing and screen is based on the types and concentrations of contaminants detected in groundwater during the previous investigation (see Table 2.2-2), the use of proper purging procedures to assure representative samples, the anticipated lifetime of the monitoring program (less than ten years), and the depth of the wells (less than 60 feet). Due to the anticipated low frequency of sampling, pumps will not be installed; therefore, 2-inch diameter casing is adequate."

After the well screen is placed in the borehole, a gravel pack compatible with the screen slot size will be placed 2 feet above the top of the screen. Granulated or pelletized bentonite will be backfilled above the gravel pack to a minimum thickness of 2 feet. Type I Portland cement/bentonite grout will be tremie-grouted from the top of the bentonite seal to 3 feet below the land surface.

Plant officials will determine which of the following methods will be used to complete the well at the surface:

1. If well stick-up is of concern in an area, the well will be completed flush with the land surface. The steel casing will be set 2 to 3 inches below land surface and a protective steel casing with locking steel lid will be cemented in place. The protective housing shall consist of a cast-iron valve box assembly centered in a 3-foot-diameter concrete pad sloped away from the valve box. Free drainage away from the well will be maintained within the valve box. Also, a screw-type PVC cap with Teflon or Viton O-ring will be installed on the well head

to prevent infiltration of surface water. A minimum of 1-foot clearance between the casing top and the bottom of the valve box will be maintained. The well number will be clearly marked on the valve lid box.

2. If an aboveground surface completion is used, the well pipe will be extended approximately 2 feet above land surface. If the well is located near a depression or creek with a history of flooding, this extension (riser) shall be higher than the flood stage. An aboveground end-plug or casing cap will be provided for each well. The riser pipe will be shielded with a steel casing which is placed over the riser pipe and seated in a 2-foot-diameter by 4-inch-thick concrete surface pad. The pad will slope away from the well casing. A lockable steel cap or lid will be installed on the steel casing and 3-inch-diameter steel guard posts will be installed if the plant determines the well is in an area that needs such protection. The guard posts shall be 5 feet in height and installed radially from each wellhead. The guard posts will be set approximately two feet into the ground and the protective steel and guard posts will be painted. The well will be clearly numbered on the lid exterior.

All groundwater monitoring wells will be developed after the well is installed. Prior to development, the wells will be examined for the presence of hydrocarbons using an interface probe, and water levels will be taken to the nearest 0.01 foot with respect to the established survey point on top of the well casing.

The wells will be developed using a submersible pump, bailer, or surge block. A bailer or surge block will be used to develop zones with lower hydraulic conductivities; a submersible pump will be employed if highly conductive zones are to be developed. The wells will be purged until a minimum of three well volumes (based on borehole diameter) of water have been displaced and the pH, temperature, specific conductance, color, and odor of the discharge have stabilized using the following criteria: pH + or - 0.1 unit, temperature + or - 0.5^{o}C, and specific conductance + or - 10 umhos.

Locks will be provided for both flush and aboveground well assemblies. The locks will be master keyed and turned over to the Plant Engineer. For each well, a well log or well schematic showing how the wells were ultimately constructed will be prepared. Preliminary schematics showing the general design of the two well types are shown in Figures 5.2-1 and 5.2-2.

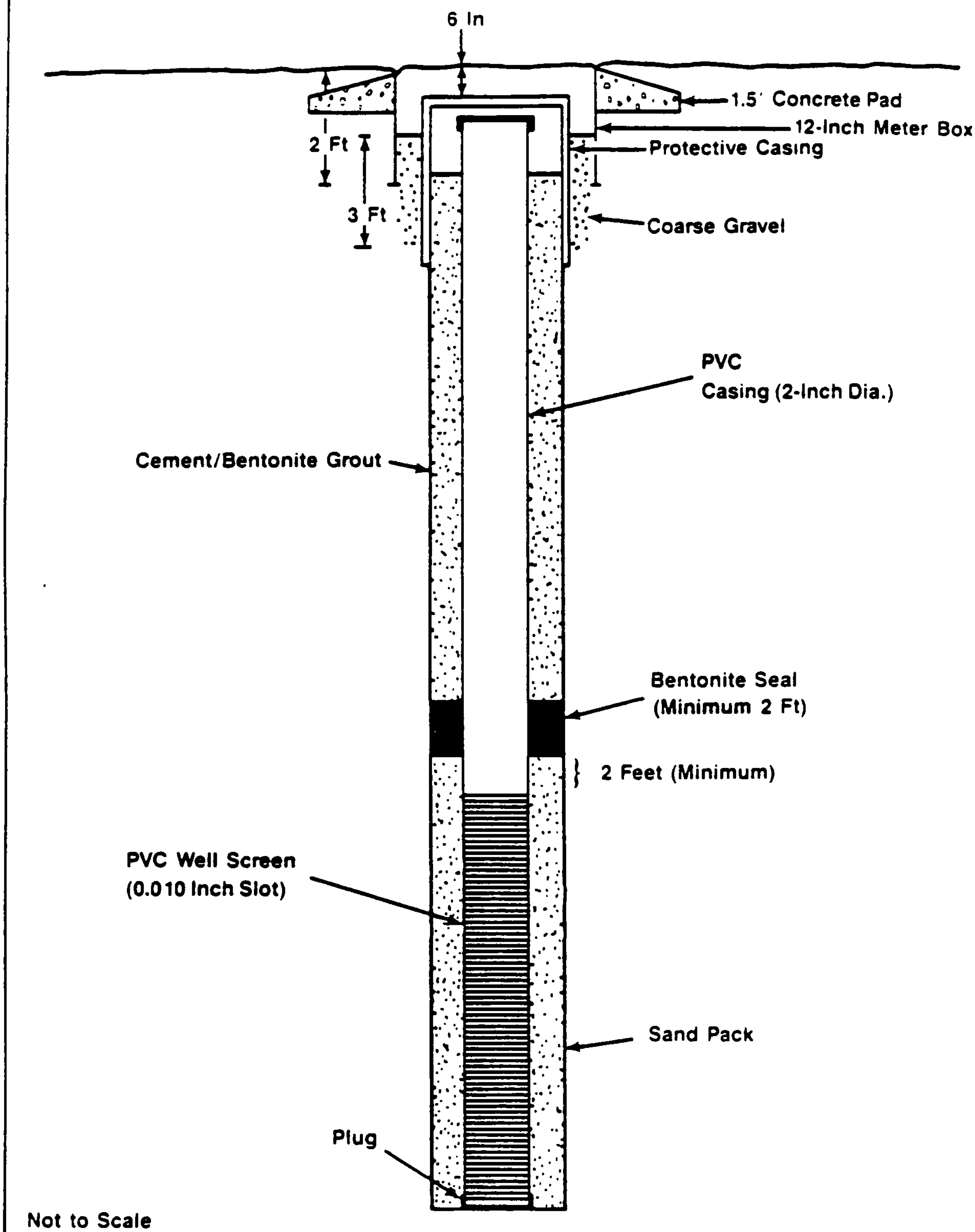


FIGURE 5.2-1. TYPICAL MONITOR WELL CONSTRUCTION--BELOW GROUND COMPLETION

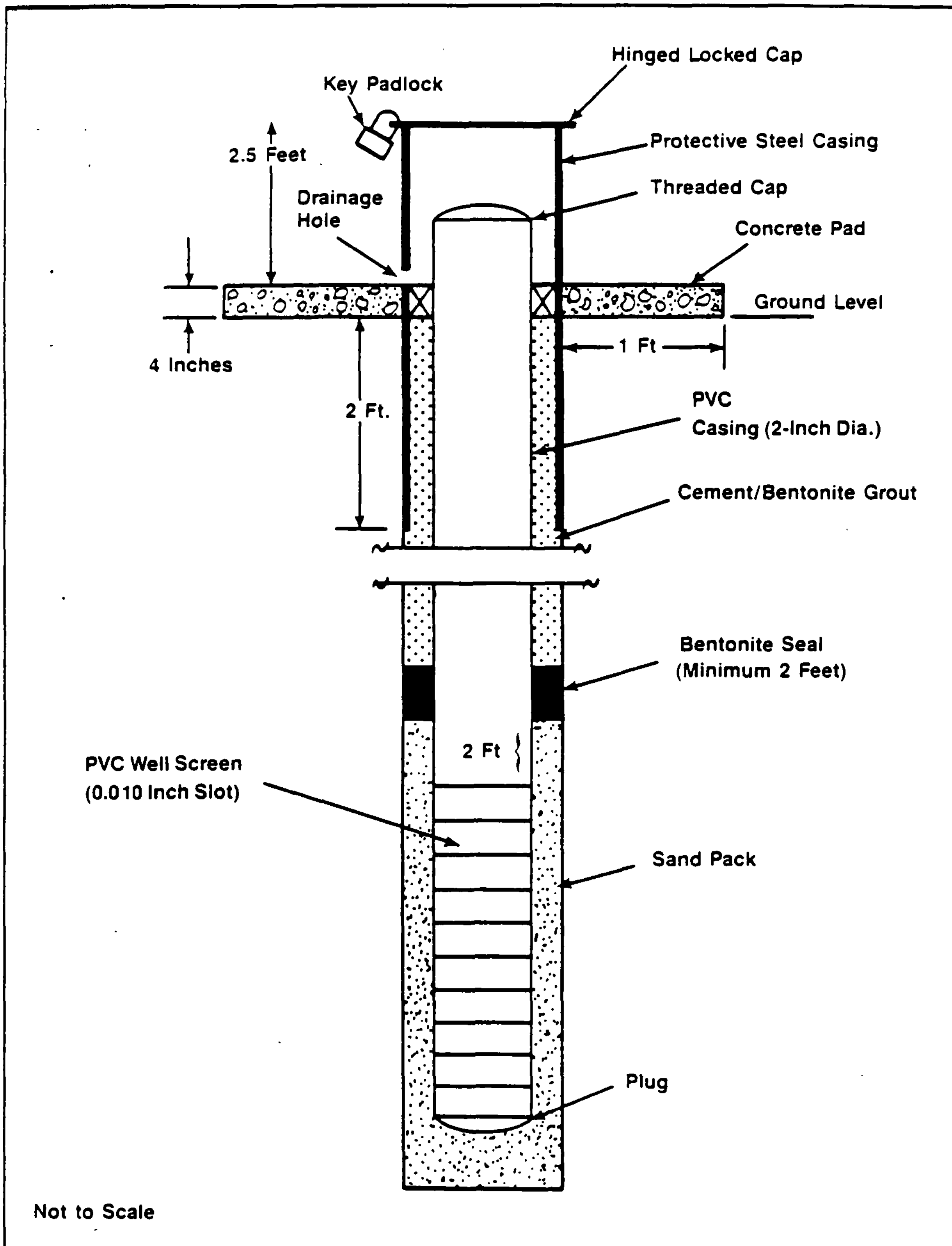


FIGURE 5.2-2. TYPICAL WELL CONSTRUCTION--ABOVE GROUND COMPLETION

Decontamination and Clean-Up. All equipment used for well purging will be decontaminated prior to and after use at each well. This includes all pumps and downhole equipment not permanently installed. The decontamination procedures will be similar to those described for drilling equipment in Section 5.2.1.3.

All well/borehole cuttings will be removed per the direction of the Plant Engineer. Cuttings suspected of being contaminated will be containerized and transported to a location within the installation boundary designated by the Plant Engineer. The plant will be responsible for the ultimate disposal of contaminated soils, using plant resources.

Surveying. A professional surveyor will be subcontracted to perform surveying of all new monitoring wells. General elevations and locations of wells tied to plant coordinates will be established prior to drilling and then casing elevation and exact location will be established prior sampling.

5.2.1.6 Aquifer Tests

Each new monitoring well and each existing well at AF Plant 85 will be slug tested, resulting an assessment of the range of permeabilities in soils present at the site. A slug test consists of imposing an instantaneous change in the water level of the well, either by suddenly introducing or removing a known volume of water and observing the recovery of the well with time. The values of residual head, as the well returns to equilibrium, are plotted versus time on semilog paper and are matched to a particular type curve for wells of finite diameter.

Analysis of the slug test data can be accomplished by a variety of techniques. The methods of Papadopolous (1973) and Cooper et al. (1967) are commonly used. The objective of the test is to determine hydraulic conductivity or transmissivity so that groundwater flow directions and travel times, and the extent of any contaminant plumes, can be best interpreted. The details of slug testing and analysis are provided in the QAPP. At this time, it is assumed that slug tests will adequately characterize the hydrogeologic units at the site. They are relatively quick, simple and inexpensive means of gaining aquifer data. Although they test a relatively small aquifer volume, they can be run as easily or more easily than other types of aquifer tests, and are therefore appropriate for this situation.

5.2.1.7 Groundwater Samples

Groundwater levels in wells will be measured using a probe-and-cable assembly. Water levels will be measured in feet below the top of casing to the nearest 0.01 foot.

Sample analysis requires the integrity of the samples be assured by using proper collection procedures. The sample must be representative of the aquifer of concern. The most conductive portions of each screened interval is likely to be represented more frequently in the samples. This is appropriate since they are most likely to transmit and contain contaminants. Each well will be properly prepared prior to sample withdrawal. Prior to purging each well to remove stagnant water in the casing before sampling, the surface of the water table will be examined for the presence of hydrocarbons through the use of an interface probe. Stagnant water in the casing will then be removed so that the sample can be taken from water that has recently entered the well from the aquifer. This will be accomplished by removing three times the volume of water standing in the well. If a well is encountered which is easily pumped dry, the well will be evacuated and the well will be sampled upon recovery. Water evacuated from the well will be disposed of some distance from it so that there is no likelihood of immediate recharge from the surface. If the water is determined to be hazardous, based on HNU or OVA readings it will be drummed and turned over to AF Plant 85 personnel for disposal.

Sampling will be done after pH, temperature, and conductivity have stabilized in water drawn into the casing from the subject zone during purging. This will ensure that representative sample are taken. Samples will be collected from the purged wells with a Teflon bailer attached to a monofilament line or stainless steel wire. The first water withdrawn after purging will be used to rinse the sample container, then water will be poured directly into the sample jars. The sample jars will be glass and will be pre-labeled. The labels will conform to the specifications in the QA Plan and the chain-of-custody requirements described therein will be followed. All samples will be handled, packed, and shipped in accordance with procedures outlined in the QA Plan.

Decontamination. The water level indicator is a probe-and-cable assembly and will be decontaminated before use in each well. The probe and cable will be cleaned with a disposable, soap-impregnated cloth and rinsed with water, then methanol, then distilled water, and wiped dry. The Teflon bailer and wire will be decontaminated prior to sampling and between samples using the same method described for sampling equipment in Section 5.2.1.5.

5.2.1.8 Trenching

No trenching is planned.

5.2.1.9 Drum Sampling

If soil encountered during borehole and well drilling is suspected to be hazardous because of abnormal discoloration, odor, or air monitoring levels, the cuttings will be placed in 55-gallon drums. At the end of the drilling phase of work, one composite sample from each drum will be collected. Each composite sample will be tested for metals (EP Toxicity), volatile organic compounds (Method SW5030/SW8240), and for base/neutral and acid extractable organic compounds (Method SW3550/SW8270) to determine if the soil cuttings must be disposed of as hazardous waste.

5.2.1.10 Stream Water Sampling

Stream water sampling of Mason's Run (Site 5) will be conducted in a timed approach. The time it takes water in Mason's Run Creek to enter and exit the AF Plant 85 facility will be estimated as a way of examining surface water quality changes. This time is a function of stream velocity, which will be measured and divided into the channel length to derive an average travel time.

Specific steps to be followed in the collection of stream water are outlined below.

1. Measure stream water velocity on Mason's Run Creek entering AF Plant 85 property. Flow velocity will be measured with a flow meter using the method of measurement developed by the U.S. Geological Survey (Buchanan & Somers, 1969).

2. Measure stream water velocity on Mason's Run Creek leaving the property. Use standard USGS practices as stated in 1 above.

3. Determine the average stream velocity using the two measured velocities above. Measure channel length and calculate average stream water travel time by dividing channel length by the average stream velocity.

4. Check calibration of pH and specific conductance meters and temperature probe and record in bound notebook.

5. Submerse a pond sampler or sample container to collect a sample of surface water at Mason's Run Creek entry point. Measure pH, specific conductance, and temperature; record in bound notebook.

6. Collect the necessary volume of water for sample analysis. Record time of sampling and observations of sample conditions in bound notebook.

7. At Mason's Run Creek exit point, repeat steps 5 and 6, after the average travel time since the first sample has elapsed.

5.2.1.11 Stream Sediment Sampling

Sediment or sludge samples will be collected using a stainless steel scoop, dredge, or coring device. All sampling equipment will be thoroughly decontaminated between samples and rinsed with surface water from the site prior to sampling.

Specific steps to be followed in the collection of stream sediment samples are

1. Collect the necessary volume for sediment or sludge analysis.

2. Record the time of sampling and observations of sample conditions in a bound notebook.

5.2.1.12 Well Repair and Restoration

Frost damage has occurred in and around the concrete pad at some of the existing well sites. Where damage is extensive, the concrete will be completely removed and replaced. Maximum frost depth has extended to approximately 32 inches in Columbus. Soil around the well will be removed to this depth so that the concrete will be poured below the frost line. At wells where minimum damage has occurred, patch work will be completed to secure the well.

The concrete debris will be disposed of onsite at a location designated by the Plant Engineer.

5.2.2 Evaluation-Related Tasks

5.2.2.1 Data Management

A data management plan will be developed based on the Installation Restoration Program Information Management System (IRPIMS). The IRPIMS is a computerized information system for archiving, analyzing, manipulating, interpreting, and reporting data pertinent to project control and technical guidance for the IRP. The data base is designed to

- Archive, analyze and manipulate physical, chemical, biological and geological data collected during the IRP program
- Analyze data with respect to trends or violations of environmental protection guidelines
- Produce subsets of data to form summary reports and data files which can be analyzed by environmental models and statistical algorithms
- Interpret relationships between contaminant migration and biogeochemical relationships existing at a particular site.

Predefined Codes. All documentation and procedures used during collection of sampling data will follow appropriate protocols and guidelines to eliminate data gaps. Data will be classified according to guidelines that will use predefined codes. The coded values will minimize the size of the database and will reduce the time needed to perform the data entry effort.

Data Collection Forms. Data collection forms will be used to record data gathered by field personnel or measured by laboratory technicians.

Automated Data Processing (ADP) Format. All technical data, including site information, well characteristics, hydrogeologic, geologic, physical and chemical sampling results will be provided in the USAFOEHL/TS-specified ADP format on magnetic floppy disc. The technical data will be organized in ASCII (flat files) using data fields specified in the format. Some initial constant data will be collected to provide information about sites and wells.

5.2.2.2 Hydrogeologic Assessment

The groundwater flow system, consisting of both vertical and horizontal components, will be evaluated for the AF Plant 85 site. This evaluation will consist of flow net analyses in cross-section showing vertical movement of the water, and individually in plan view for the Wisconsin Till and the Illinois Outwash. Based on conclusions drawn from the flow net analyses, the paths and velocities of contaminants through the subsurface will be determined. This assessment will consider all relevant data collected during the field investigation (e.g., information derived from soil samples).

5.2.2.3 Demographic Survey

A demographic survey will be prepared to provide an extensive description of the population around AF Plant 85. The survey will focus primarily upon the City of Columbus and other incorporated towns such as Bexley, Gahanna, and Whitehall. Data provided by the 1980 U.S. Census for the Columbus Standard Metropolitan Statistical Area (SMSA) will be combined with information from the state and local level. Demographic factors such as age, race, sex, religion, ethnicity of population, and socioeconomic indicators such as income, education level, employment, and commercial activity will be detailed. Past, present and predicted future trends of population growth will be reported. Business and residential zoning within the particular areas around AF Plant 85 will be noted.

5.2.2.4 Evaluation and Screening of Data

Descriptive statistics used to evaluate and screen the technical significance and results of the collected data shall be calculated and provided for incorporation into the Air Force's IRPIMS. Guidelines for generating the statistics and their presentation are provided below.

- Perform statistics on all analytes, including field parameters (pH, conductance, temperature).
- Calculate statistics only when sample size (n) is equal to or greater than 3 for analyte values equaling or exceeding EPA's Practical Quantification Limits (PQL).
- Pool data for all sites and all sampling locations combined over the entire Air Force installation.
- Group data sets by individual sampling rounds. Then calculate separate statistics for groundwater, surface water, and sediment sample data.
- Calculate the following statistics using the above criteria:
  - Sample size (n), (e.g., the number of detects of TCE that equal or exceed EPA's PQL).
  - Number of detects below EPA's PQL but greater than or equal to the Method Detection Limit (MDL).
  - Number of non-detects below the MDL.
  - Total number of times a given analyte (e.g., TCE) was sampled for, regardless of whether the values were above or below the detection limits (i.e., the sum of all detects and non-detects).

- The statistics that are to be calculated below pertain to values equal to or exceeding EPA's PQL, using sample size (n) above:
  - Minimum
  - Maximum
  - Mean
  - Median
  - Mode
  - Range
  - Variance
  - Standard Deviation
  - Coefficient of Variation
  - Skewness
  - Kurtosis
- Report all of the statistics above including the number of detects and non-detects in a data matrix format. The horizontal axis of the matrix shall be the various statistics requested and the vertical axis shall be the analytes.
- If a requested statistic cannot be calculated due to insufficient data or for any other reason, then so state in the data matrix.
- Provide stem and leaf frequency plots of all analytes and field parameters grouped according to item above.

5.2.2.5 Endangerment Assessment

An endangerment assessment will be performed to evaluate the degree to which alternative remedial actions avoid unacceptable threats to human health and limit adverse effects to the environment from contaminants. The "no action" alternative will be evaluated to describe the current site conditions and to serve as the baseline for the analysis. All data on the extent of contamination, mobility and migration potential of constituents will be reviewed in relation to remedial action and pathways of contamination.

Environmental Areas. The potential for contamination or endangerment of threatened or endangered species, habitats, or other natural settings needs to be considered in relation to the results of the Phase II Stage 1 investigation. Urbanization in the vicinity of AF Plant 85 has decreased the amount of natural habitat space for vegetation and wildlife. No endangered species of vegetation are known to exist in the vicinity of AF Plant 85. However, the potential for a few natural areas located near the plant to be affected by air or water contaminants will be evaluated in the assessment. Four areas of concern identified by the Ohio Division of Natural Areas and Preserves for the purposes of the Phase II Stage 1 investigation include

1. A 1-mile stretch of Big Walnut Creek south of Morse Road, approximately 1 mile north of Gahanna and 4 miles upstream from AF Plant 85, is the habitat of Hiodon tergisus (Mooneye), a State endangered fish.

2. A 2,000-foot stretch of Big Walnut Creek in Gahanna, approximately 1 mile northeast of and upstream from AF Plant 85, is the habitat of Etheostoma maculatum (spotted darter), a State endangered fish.

3. The Gahanna Woods Natural Preserve, approximately 3 miles northeast of AF Plant 85, is owned by the Ohio Department of Natural Resources and managed by the City of Gahanna Parks. The preserve comprises over 50 acres, where visitors can enjoy four different habitats. Small woodland ponds and a buttonbush swamp occupy the low-lying areas. A pin oak/silver maple swamp forest rings these areas, followed by oak/hickory and beech/maple associations on the higher and drier sites. Woodland wild flowers include the yellow water crowfoot, Canada lily, swamp saxifrage, wild hyacinth, skunk cabbage, and trillium. The preserve also includes an old field community of goldenrods, sunflowers, and asters.

4. A smaller 6-acre area of land immediately south of Gahanna Woods is the habitat for the Hemidactylium scutatum (four-toed salamander), a State endangered salamander.

Exposure Pathways. A number of pathways exist which could potentially result in the exposure of habitats or species to contaminants from AF Plant 85. The pathways include air, surface water, groundwater, and food chain contamination.

- Air contamination: Air contamination is expected to be a non-significant source of exposure due to the fact that contaminated soils which could otherwise be subject to dispersion in fugitive dust are adequately covered with vegetation. However, should these areas be excavated for remediation or other purposes, the potential for air contamination would be increased.

- Surface water contamination: The potential exists, especially under flooding conditions, for chemical compounds identified in the Phase II Stage I investigation of Mason's Run (Site 5) to be dispersed and discharged offsite. Such migration could endanger surrounding species and habitats. Fish kills have been reported in Mason's Run in areas outside the plant boundaries. Recommended channelization of Mason's Run onsite will alleviate further accumulation of chemical constituents.

- Groundwater contamination: Groundwater sampling at AF Plant 85 demonstrated the presence of manganese, sulfate, and TDS at levels exceeding the SDWS for these constituents. Halogenated organic chemicals were also found to be present in the groundwater. Although hazardous chemicals were not identified from groundwater analyses, hydrocarbons and solvents were identified in soils below the water table. Continued monitoring of groundwater has been recommended. Use of groundwater from private wells drilled in the Wisconsin Till or Illinoisan Outwash near the Plant could potentially provide an escape route for contaminants, resulting in human exposure.

- Food chain contamination: Food chain contamination could potentially occur through migration of chemical contaminants through the air or water. In addition, vegetation covering contaminated soils onsite could serve as a source of potential food chain contamination should rodents or birds feed at such sites.

5.2.2.6 Map Preparation

Maps will be prepared to illustrate the sampling investigations conducted at each site at AF Plant 85. These maps will be based on existing maps available from USGS and/or from AF Plant 85 file drawings. Specific maps to be prepared will include maps of potentiometric surface, new well locations, sampling locations, and distribution of contaminant concentrations from chemical analysis of the collected samples. Three-dimensional diagrams will be used to display water quality. Map preparation will consider all relevant data collected during the field program.

5.2.2.7 Treatability Studies

Decisions to be made in the screening of remedial technologies will depend, in part, on treatability information for soil and groundwater. Existing information on the physical properties and chemical characteristics of soils and the chemistry of groundwater may need to be supplemented during the FS screening process with bench scale testing to address detailed technical aspects and economic considerations of certain treatment technologies. Close coordination with the USEPA will be maintained in order to take advantage of any transfer of data on groundwater or soil treatment technologies utilized at other sites with similar conditions.

5.2.2.8 IRP Reports

The contents and scheduling requirements for the preparation of the IRP reports is outlined in Section 6, Reporting Requirements.

5.2.3 Feasibility Study Tasks

The Feasibility Study (FS) will begin with the evaluation of general response actions identified from site information obtained during the IRP field investigation program and summarized in the IRP Stage 1 report. Additional site information collected in the IRP Stage 2 field program, described in Section 5.2.1 of this plan, will be factored into the Feasibility Study as it becomes available. The Feasibility Study process is shown on Figure 5.2-3 and consists of steps that are addressed in the following sections of this plan.

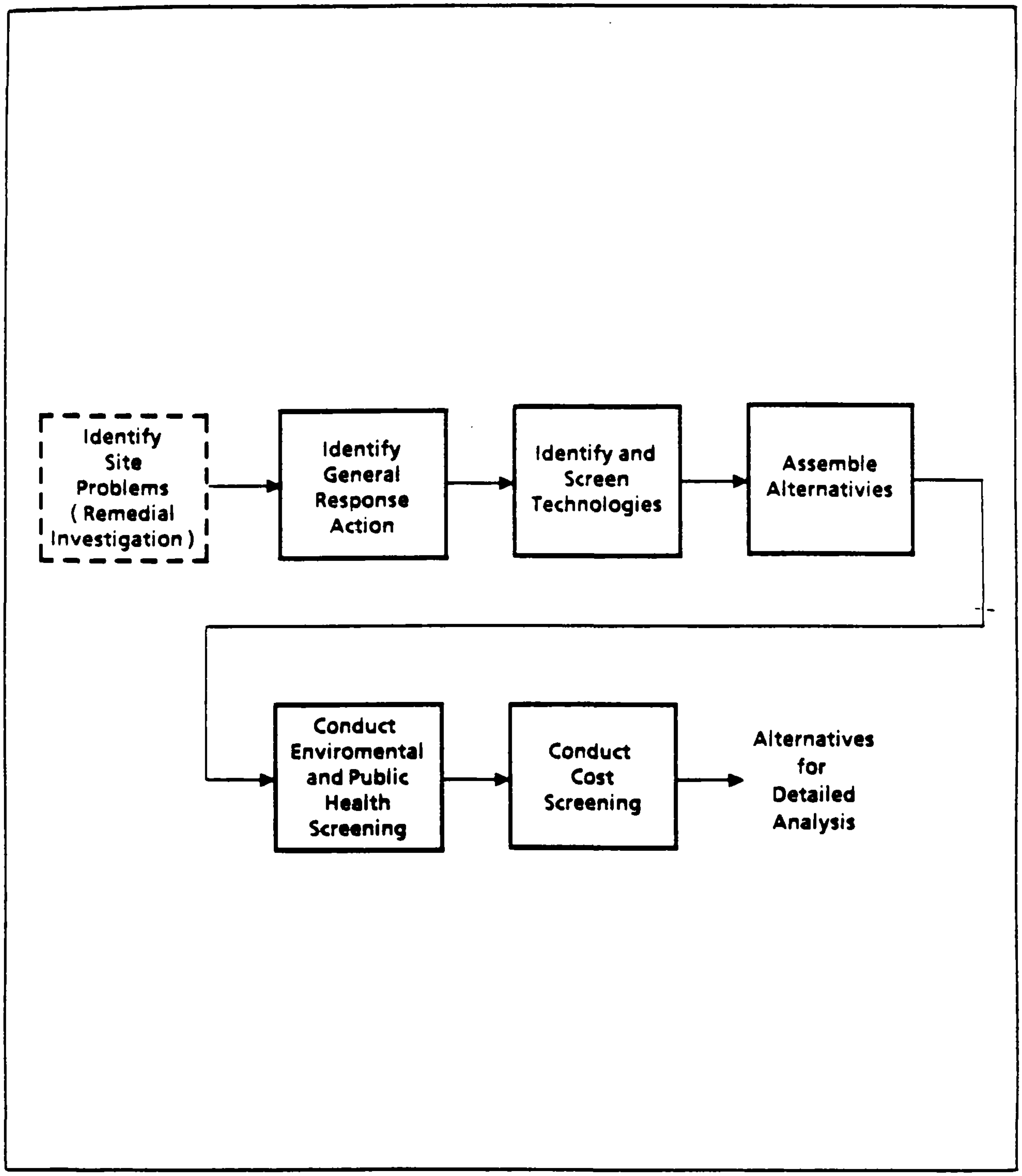


FIGURE 5.2-3. FEASIBILITY STUDY ALTERNATIVE DEVELOPMENT AND SCREENING PROCESS

5.2.3.1 Identification of General Response Actions

Based on site information from the IRP Phase II Stage 1 investigation, one of the sites was categorized as requiring no further action and four sites were classified as requiring immediate remedial action. Table 5.2-1 summarizes the contaminant conditions and further investigative work recommended in IRP Phase II Stage 1 at each of the sites.

General responses actions will be identified for each of the four sites that address site conditions and contaminant pathways, that meet other applicable or relevant Federal and State public health and environmental standards and laws (ARARs), and that are effective in preventing the release of contaminants so that they do not migrate to endanger the present or future public health or the environment. Examples of such general response actions are listed in Table 5.2-2.

5.2.3.2 Identification and Screening of Technologies

Potential treatment technologies and their assorted containment or disposal requirements for remediation of soil and groundwater contamination will be screened for their technical applicability to the sites (Table 4.4-1). Technologies found to be appropriate will be combined to form alternatives for source control and/or management of migration measures. Data collected in IRP Phase II Stages 1 and 2 that identify site characteristics that could limit or promote the use of certain remedial technologies will be evaluated as part of the screening process. Technologies that are clearly limited by site characteristics, contaminant properties, or that may prove difficult to implement will be eliminated from consideration.

5.2.3.3 Development of Alternatives

Based on the results of the RI and consideration of potential remedial technologies, a limited number of alternatives will be developed, ranging from an alternative that, to the degree possible, would eliminate the need for long-term management at the sites to alternatives involving treatment that would reduce toxicity, migration, or volume. In addition, an alternative

TABLE 5.2-1. SITE CHARACTERIZATION AND RECOMMENDED FUTURE ACTIONS

Site	Conditions	Future Actions
Coal Pile Leachate Site (Site 2)	No contaminant found to be at unacceptable health levels	No further action
Mason's Run (Site 5)	Oil and grease, chromium, lead, and nickel in stream sediments; elevated TDS in surface water and groundwater	Long-term monitoring of groundwater and channelization of the stream bed
PCB Spill Site (Site 3)	PCBs in soil	Soil sampling at the site and sediment sampling at Mason's Run
Fire Department Training Area (Site 4)	Oil and grease, organic solvents in soil	Additional groundwater monitoring to characterize extent and concentration
James Road Hazardous Waste Storage Area (Site 8)	Oil and grease, toluene, dichloroethane, trichloroethane	Additional groundwater monitoring

TABLE 5.2-2. EXAMPLES OF GENERAL RESPONSE ACTIONS

• Containments
• Pumping
• Collection
• Diversion
• Removal - partial, complete
• Treatment - onsite, in-situ
• Storage
• Disposal - onsite, offsite
• No action

involving containment with little or no treatment will be included in the range of alternatives. The alternatives will be developed in consultation with the USEPA and will be oriented toward site-specific information obtained from the RI field investigations.

5.2.3.4 Screening of Alternatives

This screening step is intended to narrow the number of alternatives for further evaluation. Three considerations will be used as a basis for the screening:

- Effectiveness: alternatives must effectively contribute to the protection of public health and the environment and not pose significant adverse environmental effects by their implementation
- Implementability and Reliability: alternatives must be feasible for the location and conditions, achieve the remedial action objectives in a reasonable time frame, and be a reliable means of addressing the problem
- Cost: cost effectiveness will be evaluated as the last step in the process to compare costs of operation and maintenance between remedial alternatives that utilize treatment technologies to achieve protectiveness to the maximum extent practicable.

5.2.3.5 Technical Evaluation of Alternatives

A detailed evaluation will be conducted of the limited number of alternatives passing through the initial screen. Detailed analyses of each alternative will involve refinement of established technology performance factors and detailed cost estimation by present-worth analysis, including distribution of costs over time. Alternative analysis will also focus on comparative environmental assessments, public health analysis, and institutional analysis to strive to reach the best balance among alternatives. Finally, alternatives will be evaluated against implementability factors, particularly the technical and administrative feasibility of implementing and maintaining the alternative.

5.2.3.6 Institutional Requirements Evaluation

The effects of Federal and State requirements (ARARs) and other institutional considerations on the design, operation, and timing of each alternative will be considered. The EPA Groundwater Protection Strategy also will be given special consideration in the evaluation. The groundwater protection guidelines and classification system of potentially affected groundwater will be taken into account in evaluation of remedies and in establishing priorities for site remedial action alternatives.

Community relations requirements under CERCLA and public perceptions of remedial alternatives will be considered. Alternatives perceived to be unacceptable or objectionable by the community may be hindered in their implementation, timing, and costs due to delay or legal challenges.

5.2.3.7 Exposure Assessment

An exposure assessment will be performed to evaluate potential public health threats which may result from chemical constituents identified at AF Plant 85. At a minimum, a qualitative exposure assessment will be performed for contamination that will not result in human exposure where the prevention of contaminant migration is of primary concern. The qualitative exposure assessment will be largely descriptive and will consist of documented evaluations of 1) the types, quantities, and concentrations of chemicals at the site and their toxic effects; 2) target population proximity; 3) the probability of chemical releases and migration from the site; and 4) the potential for exposure. Development of appropriate control alternatives to prevent migration will also be required based on accepted engineering practices and appropriate applicable standards. The reliability of any control measures will be evaluated and monitoring provisions will be included to ensure against human or environmental exposures. The effects of "no action" will be described in terms of short- and long-term effects and exposure to contaminants, and resulting public health impacts. Each remedial alternative will be evaluated for impact reduction and compared to the no-action level.

A quantitative exposure assessment will be developed for those cases or sites where contaminants are capable of migration or transport in media resulting in human exposure. The quantitative exposure assessment involves estimation of the frequency, magnitude, and duration of human exposure to contaminants from AF Plant 85. In both qualitative and quantitative exposure assessments, the following areas will be addressed: identification of chemicals at the site, identification of surrounding populations, and identification of potential on- and off-site exposure routes.

Chemical Identification. A variety of chemicals have been disposed of, stored, or accidentally spilled at AF Plant 85 since 1941. Table 5.2-3 provides information on chemicals at the plant from a historical perspective.

For the purposes of the exposure assessment, the following information will be ascertained:

- Identification, quantification, and determination of methods of disposal/storage/spillage of chemicals at AF Plant 85 over time
- Identification of chemicals currently in the environment and their ambient levels in air, soil, surface water, and groundwater
- Identification of chemical indicators and conditions which may result in on- or off-site contaminant migration.

Sampling and analyses performed in the Phase II Stage 1 investigation provided information concerning current chemical levels in the soil, groundwater, surface water, and sediments at AF Plant 85. The results of this investigation are summarized in Table 5.2-4. The levels of the different chemicals found in the various environmental media represent the highest concentrations found at the sampling sites.

The data provided by Phase II Stage 1 investigations serve as a starting point for determination of chemicals at AF Plant 85 which may result in potential human exposures. Chemical levels in air were not studied and such monitoring will be necessary for the overall exposure assessment. Recommendations from Phase II Stage 1 included continued monitoring and sampling of the surface water, groundwater, and soil at AF Plant 85. The ranges of all chemicals and their concentrations in the various media at the

TABLE 5.2-3. HISTORICAL PERSPECTIVE OF SITES AND POTENTIAL CONTAMINANTS AT AF PLANT 85

Site	Period of Use	Potential sources of contaminants
Coal Pile Leachate Site (Site 2)	1941 to present	- Sulfuric acid and metals from coal storage
	1979 to present	- Sulfuric acid and metals from leachate collection system
PCB Spill Site (Site 3)	1983	- PCB transformer oil spill
Fire Department Training Area (Site 4)	1941 to 1977	- Aircraft fuel, waste oil, solvents, magnesium
Mason's Run Oil/Fuel Spill Site (Site 5)	1941 to present	- Miscellaneous spills, (oil, fuel, solvents, metals) from storm sewers
	1979	- Coal pile leachate
James Road Hazardous Waste Storage Pad (Site 8)	1941 to present	- Spills of hazardous waste including trichloroethane, acetone, solvent mixture, phenolic paint strippers

TABLE 5.2-4. CHEMICALS IDENTIFIED AT AF PLANT 85

Media	Chemical	Concentration[a]	Applicable Criterion
Soil	PCB	422 ug/g	TSCA[b]-50ug/g (Action Level)
	Toluene	140, 190 ug/kg	None
	Methylene Chloride	180 ug/kg	None
	Trichloroethane	160,000 ug/kg	None
	Dichloroethane	980, 1900 ug/kg	None
	Hydrocarbons (oil and grease)	145, 180 ug/g	
Groundwater	Manganese	0.113 mg/l	SDWS[c]-0.05 mg/l
	TDS	1162 mg/l	SDWS-500 mg/l
	Sulfate	556 mg/l	SDWS-250 mg/l
	TOX	1622 ug/l	
	Trichlorotri-fluoroethane (Freon 113)	(Suspected - unquantified)	
Surface Water	TDS	678 mg/l	SDWS-500 mg/l
Sediment	Hydrocarbons (oil and grease)	2360 ug/g	None
	Lead	95.3 ug/g	None
	Chromium	62.2 ug/g	None

[a]Highest concentration identified at sample site

[b]Toxic Substances Control Act

[c]Secondary Drinking Water Standard

sampling sites will be determined. Ambient levels of chemical constituents in the environment will be measured. The chemical and physical properties (i.e., persistence, solubility, vaporization, etc.) of the chemical compounds will also be considered in relation to these data so that the total exposure risk can be quantified. A large number of both inorganic and organic chemicals have been detected in the various media at and around AF Plant 85. In some instances, it will be necessary to select appropriate indicator chemicals in order to feasibly develop the exposure assessment.

Surrounding Population. AF Plant 85 is located approximately 6 miles from downtown Columbus, Ohio and is situated in proximity to rather sizable business and residential populations (Figure 2.1-1).

For the purpose of the exposure assessment, the following information concerning the population surrounding AF Plant 85 will be determined:

- The number of people at risk of potential exposure
- The presence of high-risk groups (children/the elderly/the ill)
- Residential/business zoning
- Plant access from the surrounding area
- Identification of health-related complaints in the area which may or may not be tied to site activities.

Potential Exposure Routes. The exposure assessment will combine information concerning surrounding populations and chemical constituents from AF Plant 85 with exposure-related data. Both on-site and off-site exposure data will be collected and analyzed, with emphasis on 1) identification of exposure routes, 2) types and concentrations of chemicals to which people are exposed through the various routes, and 3) the number of people potentially at risk. Monitoring data and modeling results will be employed to assess the magnitude and scope of potential exposures. The monitoring data will originate from the field program and from off-site surveys (where possible). The monitoring data includes water levels (head values) and chemical data generated from laboratory analysis of groundwater samples. Water level data will be taken from all monitoring wells. Chemical data will be taken from wells which undergo sampling and analysis. Modeling of the groundwater flow system will be done using the McDonald and Harbaugh (1984) finite difference modular model. The assessment of solute transport will be done using the "random-walk" model written by Prikett et al. (1981). Occupational and nonoccupational exposures will be examined. Further, consideration of ambient levels of chemicals in the environment and chemical contamination due to sources other than AF Plant 85 (i.e., surrounding industry, Port Columbus International Airport, etc.) will be factored into the exposure assessment.

The potential exposure risk attributable to chemical constituents identified at AF Plant 85 will be determined after all data concerning chemical levels, populations at risk, and exposure routes have been collected. The exposure assessment will present normal and worst case scenarios, as well as present and future conditions. The risk of any adverse health effects associated with chemical exposures will be quantified. Finally, mitigative measures for the prevention of human exposures will be described.

5.2.3.8 Environmental Impact Evaluation

An important element of the technical evaluation of remedial alternatives remaining from the screening process is the assessment of each alternative in terms of the degree it can be expected to effectively mitigate and protect the environment and public health. In addition to analyzing any adverse impacts, methods for mitigating these impacts and costs associated with mitigation will be reviewed. Environmental effects will not be evaluated when they are not within the scope of an alternative. An environmental assessment of the "no action" alternative will be made and will describe the existing site conditions and anticipated environmental conditions if no action is taken.

Any remedial alternative (action) that results in any of the following unfavorable effects will not be considered in detail:

- A substantial increase in airborne emissions
- A new discharge to surface or groundwaters
- An increase in the volume of loading of a pollutant from existing sources or a new facility to receiving waters
- Known or expected significant adverse effects on the environment, or on human use of environmental resources

- Known or expected direct or indirect adverse effects on environmentally sensitive resources or areas.

5.2.3.9 Detailed Cost Analysis of Selected Alternatives

A detailed evaluation will be conducted of the alternatives passing through the screen that utilizes site-specific factors based on vendor estimates, standard costing guides, and estimates from similar projects.

In preparing detailed estimates, the following analyses will be performed:

- Estimation of costs: remedial action activities will be distinguished between capital and operation and maintenance costs.
- Present worth analysis: expenditures that occur over different time periods will be evaluated by discounting all future costs to the present for comparison purposes.
- Sensitivity analysis: variations in assumptions used in the present worth analysis will be assessed to see the effect that such variations can have on the estimated cost.

5.2.3.10 Selection of Recommended Remedial Action

The selection of recommended remedial action at any of the sites will be based on the overall evaluation of alternatives, with selection based on the following criteria:

- Technical evaluation of remedial action technologies
- Institutional requirements evaluation
- Environmental impact evaluation
- Detailed cost analysis
- Relationship of any proposed remedial action to EPA remedial action guidelines

The lowest cost alternative that is technically feasible and reliable, and that provides appropriate protection to the environment and public health, will be considered the preferred alternative at any of the sites.

5.3 SITE SPECIFIC DISCUSSION

5.3.1 Field Investigation

Site-specific field investigations are summarized in Table 5.3-1, and discussed in the following subsections.

5.3.1.1 Mason's Run - Site 5

Stream water will be sampled at two locations along Mason's Run Creek. The two locations at which stream velocity will be measured and water samples collected are identified on Figure 5.3-1. Procedures for measuring stream velocity and collecting the water samples are discussed in Section 5.2.1.3. Stream waters will be tested in the field for pH, specific conductivity, temperature, and alkalinity. One water sample at each location will be collected, for a total of 2 water samples. Additionally, for each sampling location, a field duplicate and equipment and field blanks will be prepared and sent to the laboratory for analysis. Details on quality control (QC) samples are presented in Table 1.5-1 of the Quality Assurance Project Plan (QAPP). Chemical analysis of each sample and QC sample will consist of parameters grouped into categories of total metals, purgeable halocarbons, semivolatiles, and purgeable aromatic compounds. Each parameter and its limit of detection, based on the standard method of analysis for different media, are listed and described in the QAPP.

Three sediment sampling locations have been established along Mason's Run Creek (Figure 5.3-2). Two locations coincide with the stream water sampling locations. A third is located immediately downstream of where surface runoff from the PCB Spill Site (Site 3) is estimated to enter the stream. Two sediment samples at each location will be collected, for a total of six sediment samples. One sample from each of the three locations will be used to run an EP toxicity leach test to assess the potential for contaminant release due to flooding. The second sample from each site will be used for chemical

TABLE 5.3-1. SITE-SPECIFIC FIELD INVESTIGATIONS

Site	Media	Samples
PCB Spill Site, Site 3	Subsurface Soils	8 boring locations, collect samples from 4 depths at each location
	Surface Water	2 locations in Mason's Run, collect samples and measure stream velocity at each location
	Sediment	3 locations in Mason's Run, collect 2 samples at each location
Fire Department Training Area, Site 4, and James Road Hazardous Waste Storage Pad, Site 8	Groundwater	5 new monitoring wells, collect 1 sample from each
		6 existing monitoring wells, collect 1 sample from each
Plant Perimeter	Groundwater	9 new monitoring wells, collect 1 sample from each to determine horizontal flow direction and vertical-to-horizontal flow ratio

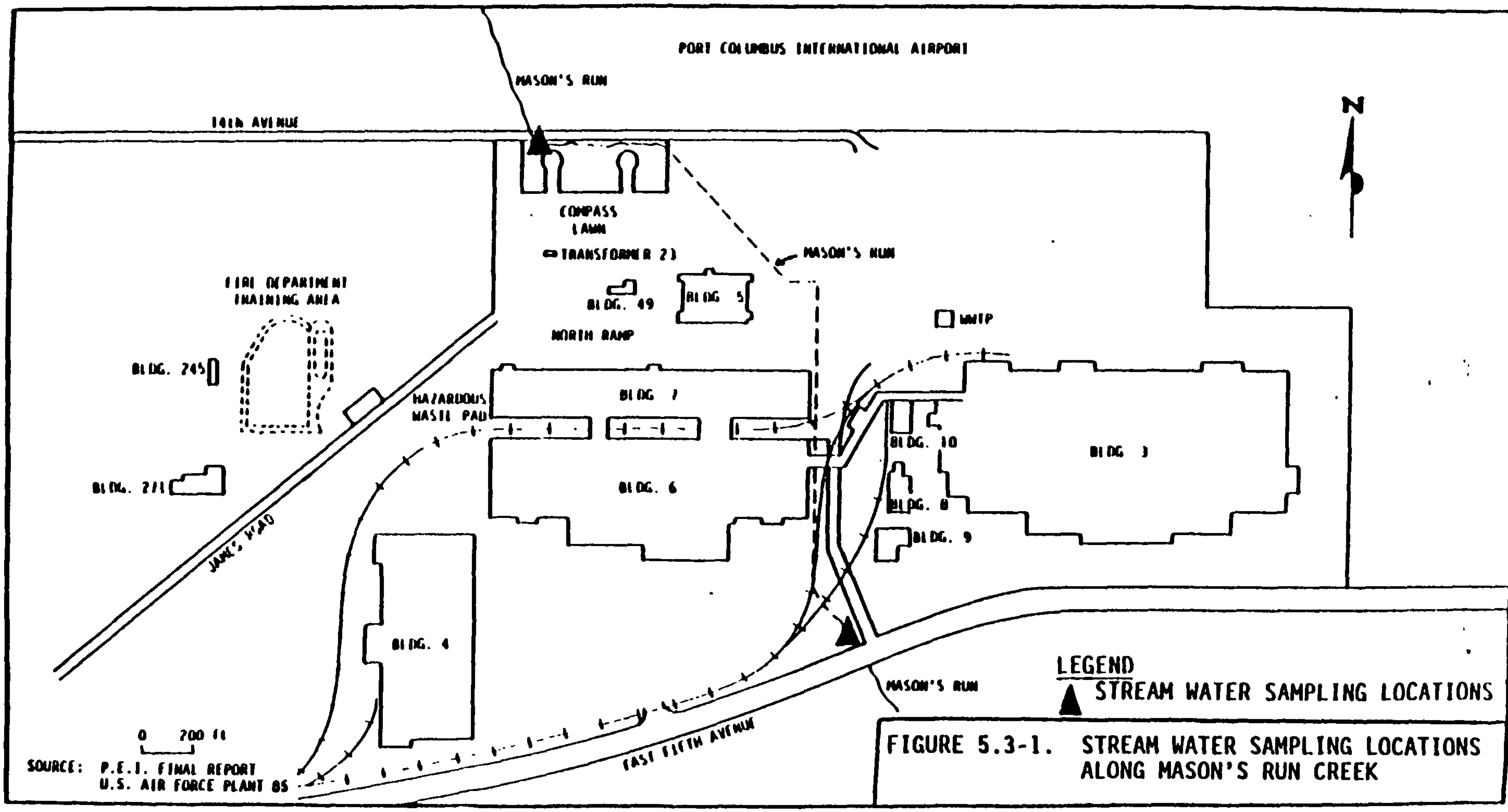


FIGURE 5.3-1. STREAM WATER SAMPLING LOCATIONS ALONG MASON'S RUN CREEK

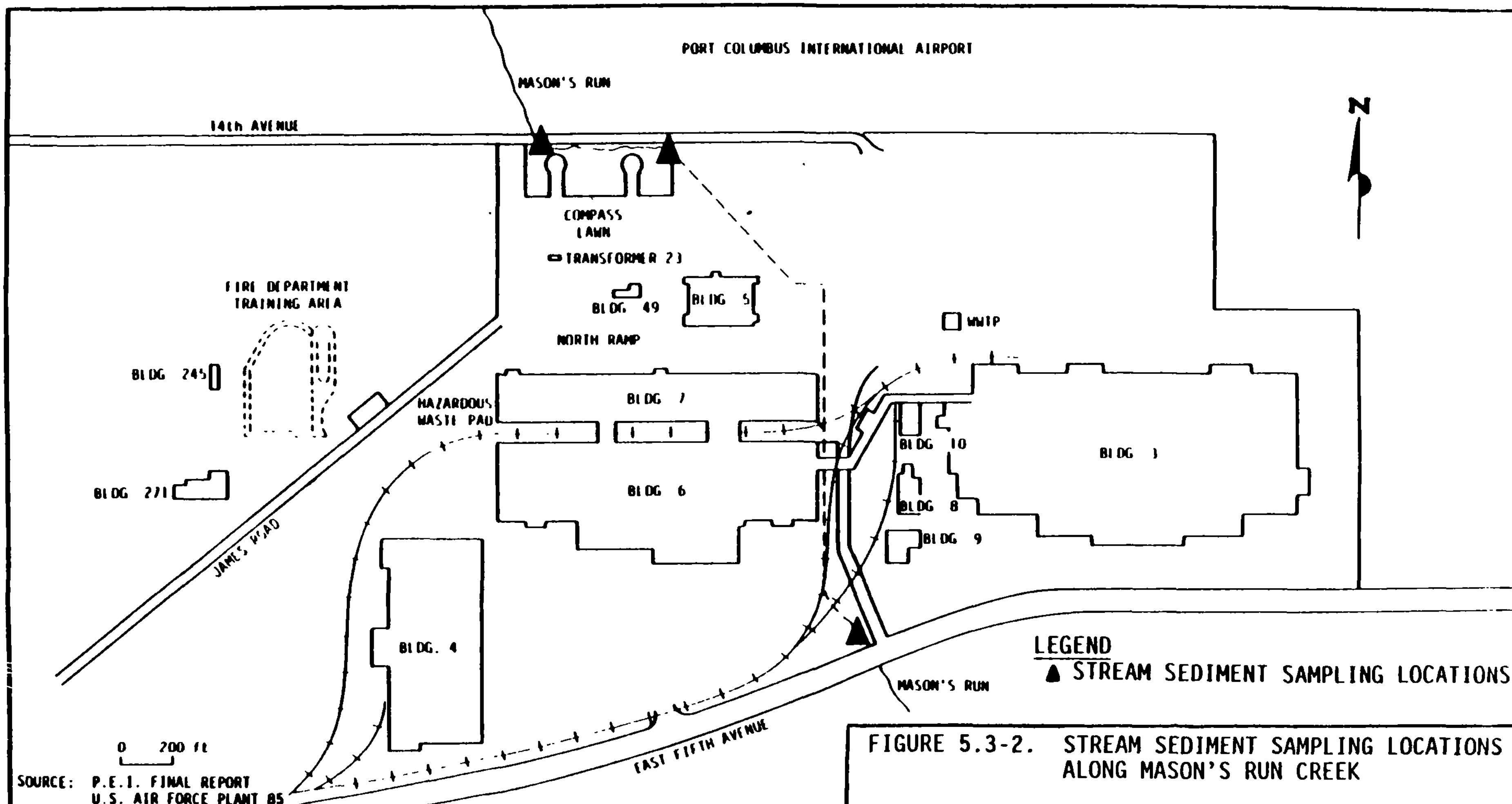


FIGURE 5.3-2. STREAM SEDIMENT SAMPLING LOCATIONS ALONG MASON'S RUN CREEK

analysis. Chemical analysis will consist of parameters grouped into the categories identified in the QAPP. Analysis for PCB is part of the procedure.

5.3.1.2 PCB Spill Site - Site 3

The extent of soil contamination at the PCB Spill Site will be determined by drilling and sampling the eight soil borings shown in Figure 5.3-3. Six borings are located at the periphery of the spill area to delineate more closely the lateral extent of contamination. Two borings are located inside the spill area to sample the present soil conditions subsequent to excavation of contaminated soil at the spill site.

All soil borings will be 10 feet in depth with 2.5-foot sampling intervals. Sampling shall begin at the 2.5 foot depth, yielding four soil samples per boring. Each sample will be analyzed for PCB levels. The QAPP contains each PCB parameter and its limit of detection.

5.3.1.3 Fire Department Training Area - Site 4

The Fire Department Training Area will be grouped with the James Road Hazardous Waste Storage Pad (Site 8) for groundwater sampling.

5.3.1.4 James Road Hazardous Waste Storage Pad - Site 8

Five monitoring wells are planned to be installed at Site 8 and Site 4 at AF Plant 85. They will be drilled by a subcontractor who will operate within State guidelines regarding the drilling and development of water wells. Any water production and well abandonment activities performed will also be within State guidelines. Table 5.3-2 lists each type of well to be installed, their screened interval, and the approximate location of each well at the site.

In October, 1987, water levels were measured from the nine existing monitoring wells at AF Plant 85 (Table 5.3-3). Graphic analysis of these measurements (Figure 5.3-4) indicates the presence of a significant downward gradient with a vertical-to-horizontal ratio of approximately 250:1 (Table 5.3-4). In addition, the outwash has a greater hydraulic conductivity than the overlying till and, therefore, represents (assuming similar horizontal

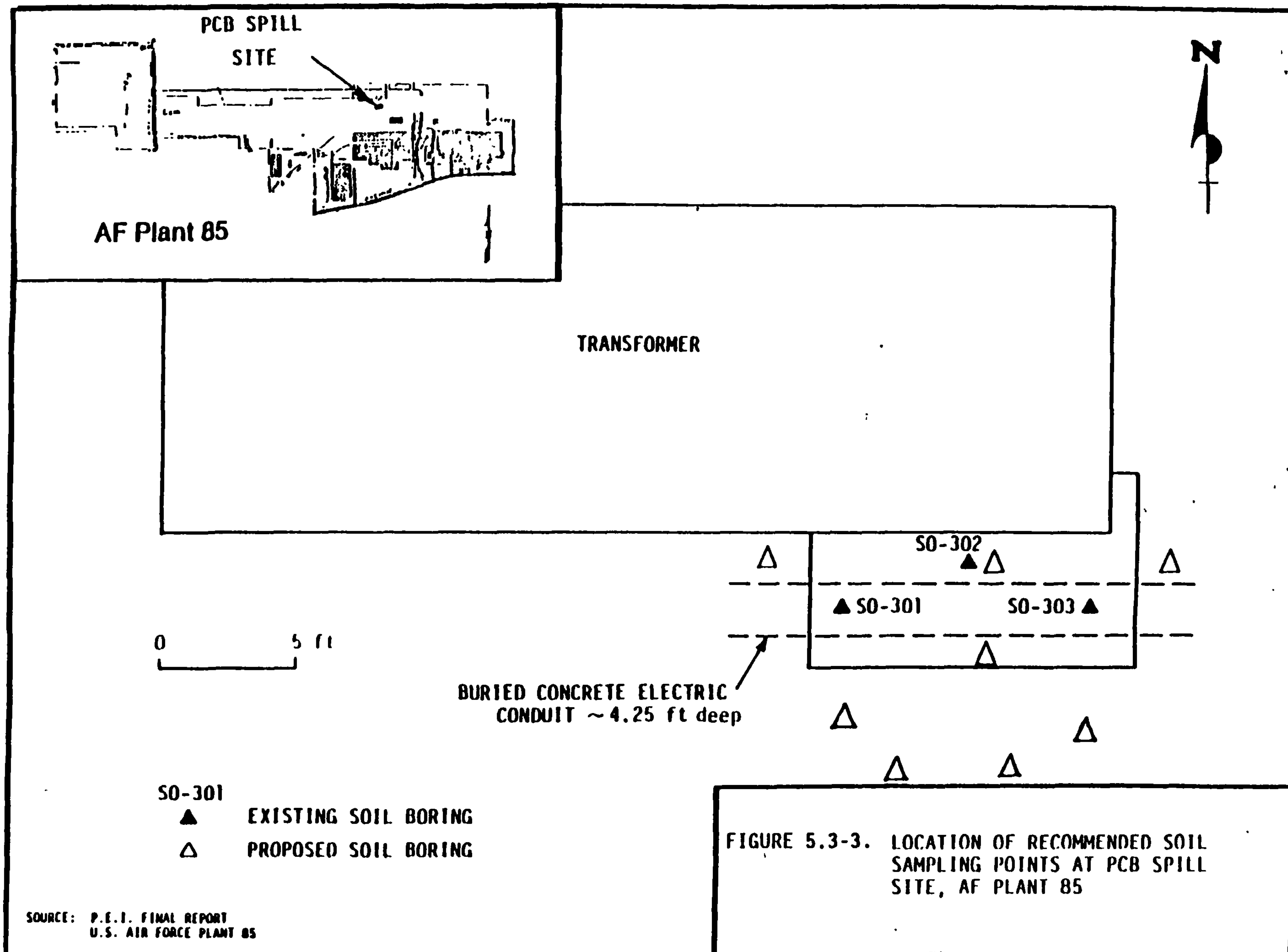


FIGURE 5.3-3. LOCATION OF RECOMMENDED SOIL SAMPLING POINTS AT PCB SPILL SITE, AF PLANT 85

TABLE 5.3-2. NEW WELLS FOR IRP STAGE 2

Well ID	Well Type[a]	Screened Internal[b]	Location[c]
1	2 inch PVC	Till	Fire Department Training Area (Site 4)/James Road Hazardous Waste Storage Pad (Site 8)
2	2 inch PVC	Outwash	James Road Hazardous Waste Storage Pad (Site 8)
3	2 inch PVC	Outwash	James Road Hazardous Waste Storage Pad (Site 8)
4	2 inch PVC	Outwash	James Road Hazardous Waste Storage Pad (Site 8)
5	2 inch PVC	Outwash	James Road Hazardous Waste Storage Pad (Site 8)
6	2 inch PVC	Outwash	NW Perimeter
7	2 inch PVC	Till	NW Perimeter
8	2 inch PVC	Outwash	NE Perimeter
9	2 inch PVC	Till	NE Perimeter
10	2 inch PVC	Outwash	E Perimeter
11	2 inch PVC	Till	E Perimeter
12	2 inch PVC	Till	S Perimeter
13	2 inch PVC	Till	SW Perimeter
14	2 inch PVC	Outwash	SW Perimeter

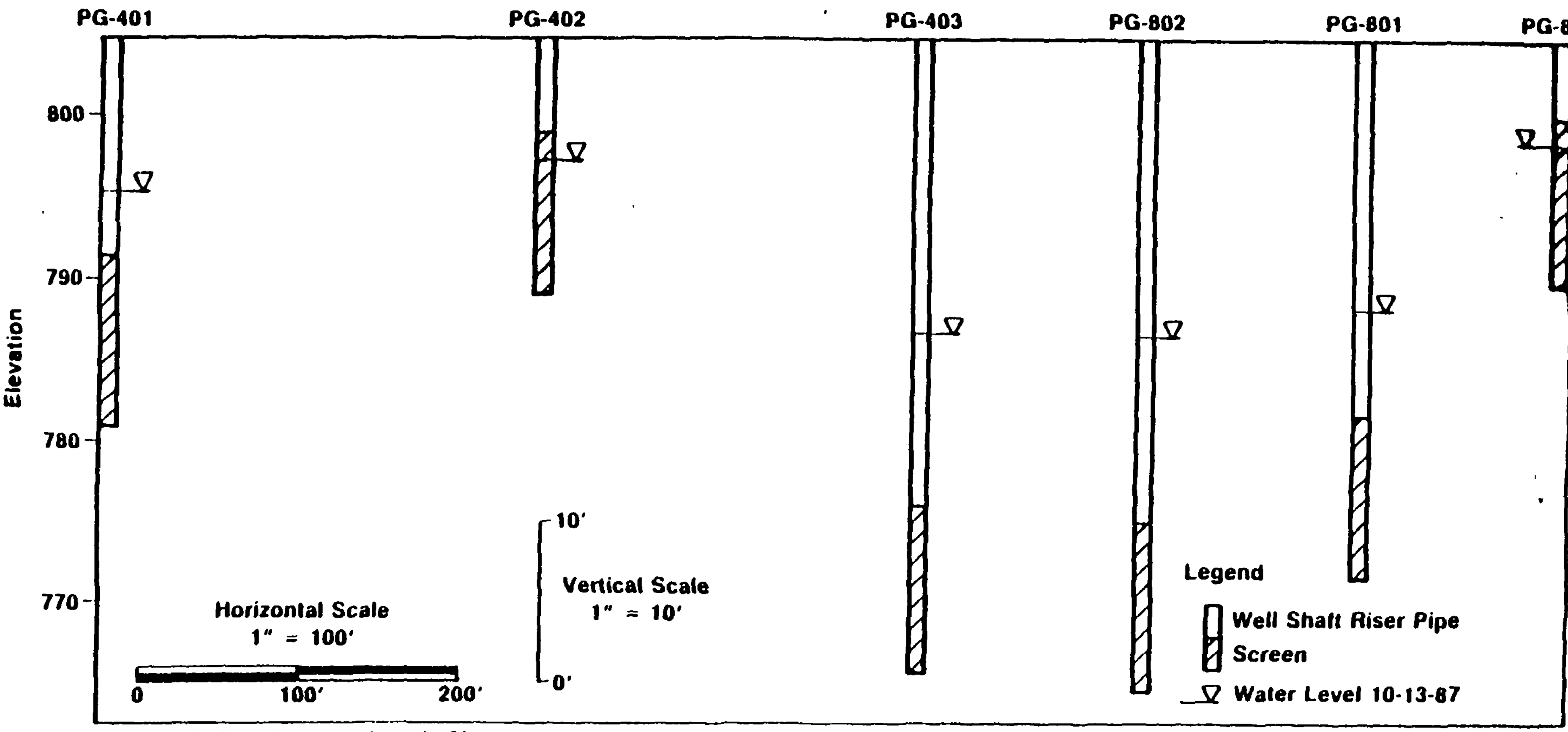
a PVC: Polyvinylchloride (Schedule 40)

b Illinoian Outwash
Wisconsin Till

c See Figures 5.3-5 and 5.3-6 for Locations

TABLE 5.3-3. WATER LEVEL MEASUREMENTS AND WELL DATA, OCTOBER, 1987

Well ID	Measuring Point (ft above msl)	Screen Interval (ft above msl)	Water Level 10-13-87 (ft above msl)	Water Level 10-22-87 (ft above msl)
PG 201	803.95	776.0 - 766.0	780.89	780.86
PG 502	801.46	775.4 - 745.4	780.68	777.63
PG 501	807.22	784.9 - 759.9	788.68	788.61
PG 803	807.21	800.2 - 790.2	798.48	798.29
PG 802	807.00	774.5 - 764.5	786.61	786.63
PG 801	807.39	782.0 - 772.0	788.18	787.97
PG 403	807.78	776.3 - 766.3	786.70	786.68
PG 402	806.64	799.1 - 789.1	797.35	797.35
PG 401	806.73	791.7 - 781.7	795.89	795.74



Note: Well locations are shown in Figure 5.3.5.

FIGURE 5.3-4. RELATIONSHIP OF WATER LEVELS IN SHALLOW WELLS TO DEEP WELLS

TABLE 5.3-4. HYDRAULIC GRADIENTS CALCULATED FROM OCTOBER 1987 WELL DATA

Well Combination	Vertical Gradient (ft/ft)	Gradient Direction	Well Combination	Horizontal Gradient(ft/ft)
PG 402-PG 403	0.26	Downward	PG 401-PG 402	0.0054
PG 402-PG 802	0.26	Downward	PG 402-PG 803	0.0024
PG 803-PG 802	0.34	Downward	PG 403-PG 802	0.00077
PG 803-PG 801	0.58	Downward		
PG 801-PG 802	0.13	Downward		
PG 401-PG 402	0.43	Downward		
PG 401-PG 803	0.90	Downward		

gradients) the most likely zone for horizontal groundwater movement and contaminant transport. At the current stage of analysis, it is assumed that the general flow direction in the outwash is dictated by bedrock topography, but it is quite possible that at select locations this is not the case. Because of this, the proposed monitoring well cluster will be installed in two phases, so that three monitoring wells can ultimately be located at downgradient positions.

Well 1 will be completed in the till (approximately 15 to 20 feet in depth) and used with the two existing shallow wells (PG 402, PG 803) near the Fire Department Training Area (Site 4) to establish the horizontal groundwater flow pattern within the till. Figure 5.3-5 locates this well in relation to the existing wells. Wells 2 through 5 will be constructed as detection monitoring wells at the James Road Hazardous Waste Storage Pad (Site 8) as shown on Figure 5.3-5. These wells will be screened in the upper 10 feet of the outwash (approximately 30 to 40 feet in depth) in order to detect any occurrence of downward-migrating contaminants entering this zone. Two of the wells will be first installed to the north and south of the storage pad (Figure 5.3-5). These two wells, in conjunction with the two existing deep wells (PG 403, PG 802), will be used to determine the horizontal groundwater flow pattern in the outwash aquifer. After the pattern has been established, the remaining two wells will be located so that one upgradient and three downgradient wells are present.

Groundwater from all wells at the James Road Hazardous Waste Storage Pad (Site 8) and the Fire Department Training Area (Site 4) (both new and existing) will be sampled once. Chemical analysis for both sets shall consist of parameters grouped into the categories identified in Section 5.3.1. The QAPP contains each parameter and its limit of detection.

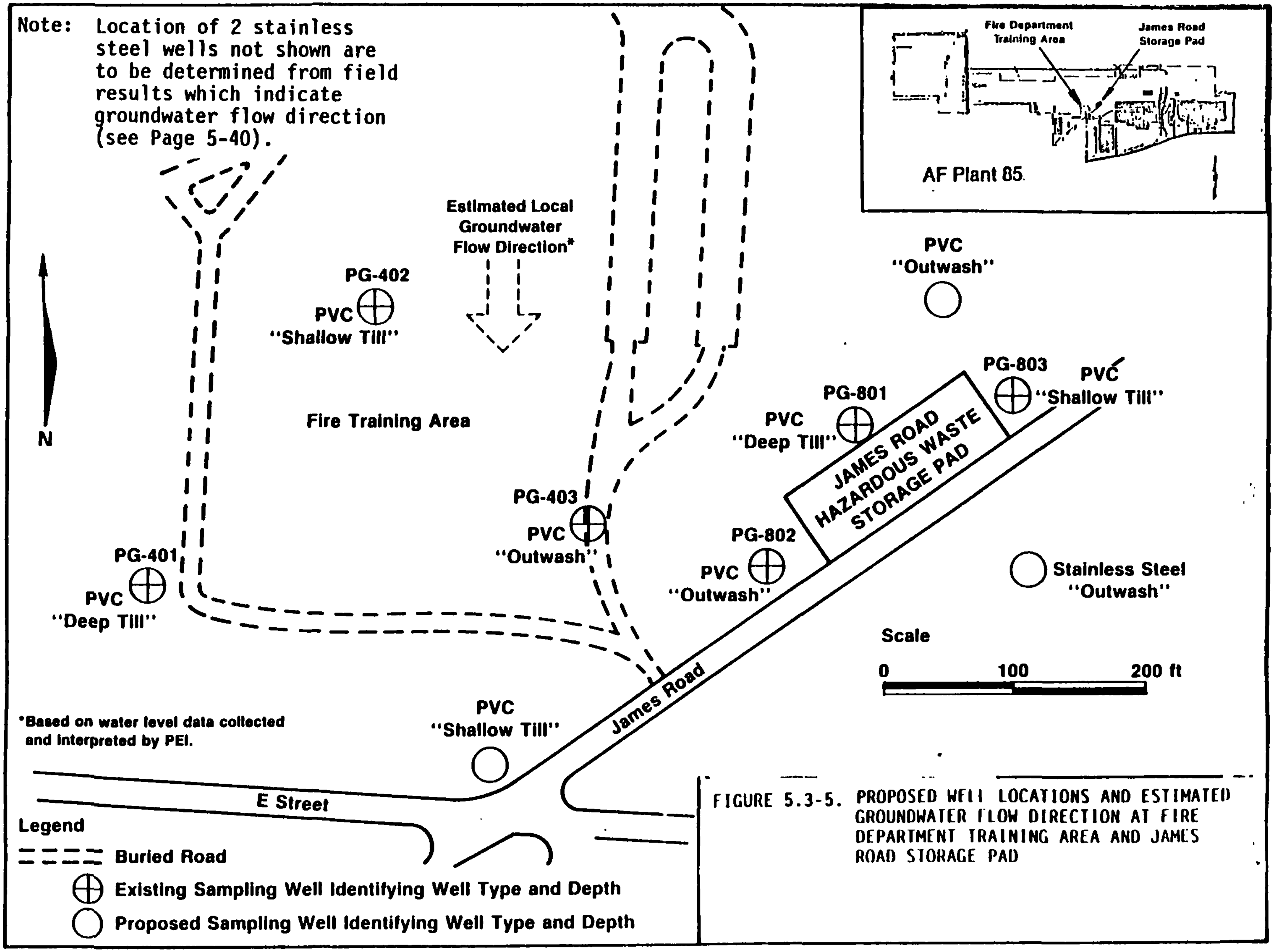


FIGURE 5.3-5. PROPOSED WELL LOCATIONS AND ESTIMATED GROUNDWATER FLOW DIRECTION AT FIRE DEPARTMENT TRAINING AREA AND JAMES ROAD STORAGE PAD

5.3.1.5 Plant Perimeter

Nine monitoring wells will be installed around the perimeter of AF Plant 85 to detect any contaminants that might be migrating offsite. Wells 6 through 14 (Table 5.3-2) will be drilled at the perimeter of the property in the southwest, northwest and northeast corners of the plant, and at the eastern and southern property lines. The locations of these wells are shown on Figure 5.3-6. The wells installed in the plant corners and the eastern boundary will be nested. The deeper wells in the nests will be drilled to bedrock and screened across the entire thickness of the outwash. The shallow wells in the nests will be screened in the till to intercept the water table, taking into account seasonal fluctuations. The single well at the southern boundary will be installed in the till near existing well PG 502, which is screened in the outwash, to establish a nest at this location.

Groundwater from all plant perimeter wells (both new and existing) will be sampled once. Chemical analysis for both sets shall consist of parameters grouped into the categories identified in Section 5.3.1. The QAPP contains each parameter and its limit of detection.

5.3.1.6 Aquifer Tests

A slug test will be performed in all new monitoring wells and in five of the existing wells (PG-402, PG-803, PG-403, PG-802 and PG-502). Results of these tests will yield hydraulic conductivity values for the glacial till and outwash and will provide data necessary to calculate travel time and estimate the extent of groundwater contamination. The details of slug testing are presented in the QAPP. The reasoning behind the selection of slug testing for this investigation is presented in Section 5.2.1.6. Travel time will be estimated by using an equation which is a derivative of Darcy's Law:

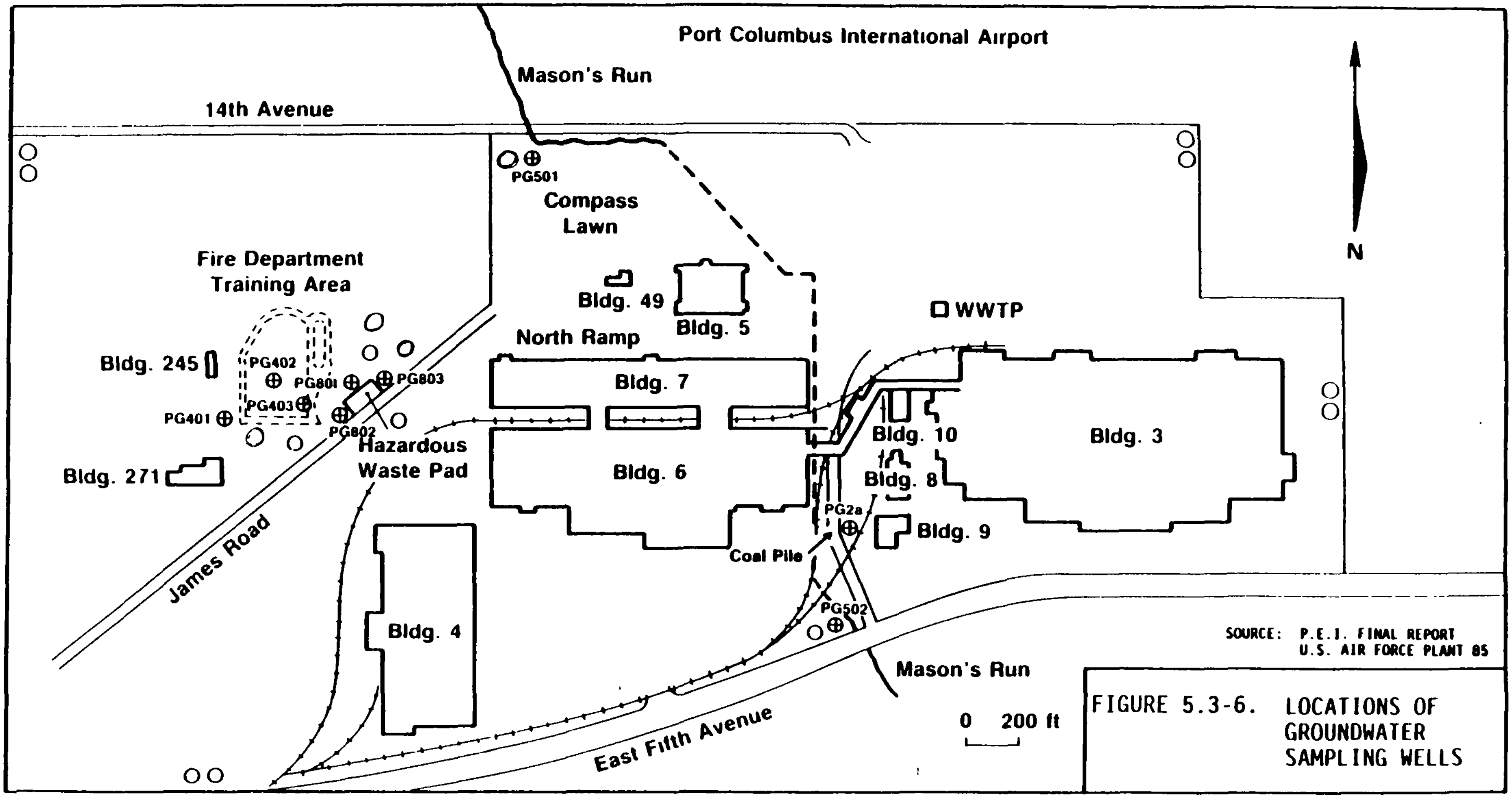


FIGURE 5.3-6. LOCATIONS OF GROUNDWATER SAMPLING WELLS

○ Proposed Well Locations

⊕ Existing Well Locations

$$t = (x\ \phi)/(k\ i)$$

where: t = travel time
x = distance to the accessible environment
ø = effective porosity
k = hydraulic conductivity
and i = hydraulic gradient

A slug test enables determination of a value of transmissivity (T). Hydraulic conductivity is derived from transmissivity using the equation:

$$T = k\ b$$

where: k = hydraulic conductivity
and b = the aquifer (screen interval) thickness

The details on any test modification resulting from preliminary test results or problems will be presented. Any problems or variance from the test procedures will be promptly relayed to the Technical Program Manager.

5.3.2 Evaluation of Alternatives

The IRP Phase I Stage 1 results recommended further investigative work at four of the five identified sites. Alternative remedial actions have not been developed at this time and no site is currently categorized as requiring remedial response. As additional information is obtained during further field efforts and remedial investigation tasks, the evaluation of alternatives undertaken in the Feasibility Study will consider appropriate remedial actions. Some of these actions can be anticipated at this time. The following sections present for each site potential alternatives currently considered as possible remedial action.

5.3.2.1 Coal Pile (Site 2)

The general response action for this site is "no action" since no primary degradation of either groundwater or soil was identified in the samples collected at the coal pile. No remediation is needed at this site.

5.3.2.2 PCB Spill Site (Site 3)

Data collected during the remedial investigation identified PCB levels exceeding the TSCA action level of 50 mg/kg. Additional investigative work was recommended to define the extent of contamination and the magnitude of the problem. Based on results of this additional investigation, complete removal of contaminated soil by excavation may be considered to be the appropriate remedial action.

5.3.2.3 Fire Department Training Area (Site 4)

Site information from the remedial investigation revealed hydrocarbon (oil and grease) and solvents (i.e., trichloroethane, toluene, and dichloroethane) present in soils to a depth of at least 15 feet and to levels exceeding 1 mg/kg. Groundwater data did not indicate the presence of solvents at the sampling points used in the investigation; however, solvents and oils were quantified in soil samples below the water table. Remedial actions at this site will be based on these findings and the additional findings which will be obtained from this Phase II Stage 2 investigation. Possible response actions are complete removal of contaminated soil by excavation, or containment by installation of a clay cap to reduce infiltration of precipitation. Lowering infiltration would reduce leaching of solvents and oils from the soil to groundwater. Excavation may be impractical due to the vertical extent and concentrations at depth of contaminants.

5.3.2.4 Mason's Run (Site 5)

Site investigations revealed that sediment in the bottom of Mason's Run near its discharge point contained high levels of oil and grease and metals (lead and chromium). Remedial actions would involve diversion, by channeling the stream bed using a culvert or concrete to isolate stream bed sediment from the environment, and collection by installing sumps to collect sediment for removal and disposal.

5.3.2.5 James Road Hazardous Waste Storage Pad (Site 8)

Soil samples from this site indicate quantifiable levels of solvents (i.e., toluene, dichloroethane) to a depth of at least 30 feet, approximately 20 feet below the water table. The presence of halogenated organic compounds (TOX) has also been confirmed in a groundwater sample taken from a well at Site 8.

No exposure criteria directly apply to soil; however, recommended 1,2-dichloroethane levels in water are 5 ug/kg, about 1/200 of that found in the soil. The presence of trichlorotrifluoroethane (Freon 113) in Well 0085-PG-803 prevented quantification of any other compound at acceptable detection limits with the method of analysis that was employed.

Additional investigative work was recommended as the response action to provide a better data base upon which to evaluate general response actions and preliminary remedial technologies. Potential remedial actions may include containment, particle removal, and treatment; however, additional data is necessary to select the appropriate technologies at this site.

6.0 REPORTING REQUIREMENTS

6.1 MONTHLY STATUS REPORT

The project manager will prepare monthly status reports to describe the technical and financial progress of the AF Plant 85 IRP Stage 2 investigation. Each report will include the following elements:

- Identification of the site and activity--AF Plant 85, Columbus, Ohio, Stage 2 IRP Investigation.
- Status of work at the site and progress to date--including activities such as well installation, sampling, chemical analysis, data analysis and interpretation, report writing, and other major activities.
- Percentage of completion and schedule status--target and actual completion dates for each item of activity, including overall project completion, will be listed. Any deviation from the milestones in the workplan will be explained.
- Difficulties encountered during the reporting period--problems will be indicated, especially those which effect the project schedule or budget.
- Actions being taken to rectify problems--corrective actions will be described and the rationale for selecting them will be discussed.
- Activities planned for the next month.
- Changes in personnel.

A Cost of Services report will be submitted at the same time as the Status Report.

6.2 INFORMAL TECHNICAL INFORMATION REPORT

Informal Technical Information Reports will be submitted after receipt of analytical results from the laboratory. The details of these reports, including information on field notes, drillers logs, lithologic logs and abandonment procedures, are cited in the QAPP. These reports contain primarily analytical data and supporting information as indicated in the annotated outline below.

1.0 Laboratory Test Results

For each sample analyzed, numerical results will be reported. Results will be reported in units as follows: organics in water samples -- ug/l; inorganics in water samples -- mg/l; soils, sediments and solid wastes -- mg/kg. Numerical results will be reported for all first-column chromatographic analyses, as well as all second-column analyses.

2.0 QA/QC Procedures

A description of the samples used for laboratory QA/QC checks will be provided, including method blanks, duplicate samples, matrix spikes, and matrix spike duplicates, etc.

Documentation of GC/MS tuning and calibrations to standards will be provided.

3.0 Sample Identification Cross-Reference

A Sample Identification Cross Reference Table (Table 6.2-1) will be included to allow the reader to easily locate analytical results for a specific sample or site.

4.0 Methods

A table of analytical detection methods used and method detection and quantition limits will be provided. Table 6.2-2 illustrates the general format to be used.

TABLE 6.2-1 SAMPLE IDENTIFICATION CROSS REFERENCE TABLE FORMAT WITH EXAMPLE ENTRIES

Field Sample[a] Number	Lab Sample Number	Sample Description	Page[b]
0085-PG-103	FE-011	Groundwater sample from well #3 at James Road Storage Pad	A-14
0085-NA-202	FE-034	Downstream surface water sample from Mason's Run.	A-52
0085-SO-203	FG-072	Sediment sample near site of PCB spill at Mason's Run.	A-95

(a) Field Sample Numbers will be assigned in the field in accordance with OEHL protocols.

(b) The page number in this column will reflect the location(s) of the lab report(s) within the Analytical Data Appendix, where all pages will be numbered consecutively.

TABLE 6.2-2. ANALYTICAL DETECTION AND QUANTITATION LIMITS TABLE FORMAT

Method Number	Analyte	Units[a]	Detection Limit[b]	Quantitation Limit
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------
______	----	----	----	--------

(a)Units will be mg/l for metals and inorganics in water samples, mg/l for organics in water samples, and mg/kg for both inorganics and organics in solid samples.

(b)Detection limits will be provided for both first and second column gas chromatographic analyses.

5.0 Holding Times

Sample collection dates, extraction dates (when applicable), and analysis dates will be displayed in tabular form (Table 6.2-3).

6.0 Chain-of-Custody Records

Copies of all chain-of-custody records associated with the site will be provided in an appendix. The forms will include sample identification information, date of sample collection, and date received by laboratory, etc.

7.0 Descriptive Statistics

Descriptive statistics will be calculated and provided for incorporation into the Air Force's Installation Restoration Program Information Management System (IRPIMS).

6.3 REMEDIAL INVESTIGATION/FEASIBILITY STUDY REPORT

The final report on the IRP Stage 2 investigation will include a description of the site and environmental setting, a review of actual field sampling activities, a single page presentation of lithologic and well completion logs (at one scale) for each well, presentation and analysis of analytical data, discussion of alternatives for further action, and recommendations. The format will be similar to the format below, and the report will include all applicable items described in OEHL's annotated outline provided in the USAFOEHL-TS Handbook.

TABLE 6.2-3. SUMMARY OF EXTRACTION AND ANALYSIS DATES

Sample Numbers	Sampling Date	Parameter Analytical Method		Parameter Analytical Method		Parameter Analytical Method		Parameter Analytical Method		Parameter Analytical Method	
		Extraction Date[a]	Analysis Date	Extraction Date[a]	Analysis Date	Extraction Date[a]	Analysis Date	Extraction Date[a]	Analysis Date	Extraction Date[a]	Analysis Date
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----
____	----	----	----	----	----	----	----	----	----	----	----

[a] If the sample does not have to be extracted prior to analysis, an "NA" (Not Applicable) will be placed in the column labeled "Extraction Date."

Report Cover

Title Page

Disclaimer

Report Documentation Page (DD Form 1473)

Preface

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5.0 ALTERNATIVE REMEDIAL MEASURES

6.0 RECOMMENDATIONS

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APPENDICES

A. Glossary of Definitions, Nomenclature and Units of Measure

B. Copy of the Task Descriptions/Statement of Work (SOW)

C. Well Data & Lithologic Logs, including:

1. Well Design & Well Completion Information
2. Drilling Logs
3. Lithologic Descriptions of Rock Units Penetrated

D. Raw Field Data

1. Geological
2. Hydrological Data (including pH, temperature & conductance)
3. Geophysical Data
4. Geotechnical & Engineering Data

E. Surveying Data

F. Chain-of-Custody Forms

G. Analytical Data for water, sediment, air, and biological sampling, including internal quality control data such as lab blanks, spikes, and lab duplicates. Hard copies of the data will be included in this Appendix. Computerized data files (5-1/4-inch floppy disks or magnetic tapes) will be provided separately in protective shipping envelopes and referenced here. Provide a cross-reference table for sample identification, a table showing analytical detection and quantitation limits, and a table summarizing extraction and analysis dates.

H. Any correspondence with Federal, state, and/or local governmental agencies.

I. Data from related or previous IRP Investigations. This Appendix shall include data or text from other investigations that are pertinent to this particular IRP effort.

J. Biographies of Key Personnel.

7.0 SCHEDULE

The schedule for the AF Plant 85 IRP Stage 2 activities is shown in Figure 7.0-1. Preparatory tasks will be largely completed, and field tasks will begin, two weeks after the Notice to Proceed.

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                        WEEKS . 1  . 2  . 3  . 4  . 5  . 6  . 7  . 8  . 9  . 10 . 11 . 12 . 13 . 14 . 15 . 16 . 17 . 18 . 19 . 20 . 21 . 22 . 23 . 24 . 25 . 26 . 27 . 28 . 29 . 30 . 31 . 32

PREPARATION TASKS
 Site Planning Visit          |-|
 Field Team Prep.             |--------|

FIELD TASKS
 Mobilization                      |---|
 Well Drilling                          |-------------|
 Well Development                         |--------------|
 Slug Tests                                                        |---------|
 Soil Borings                                               |---|
 Well Repair                                             |----|
 Sediment Sampling                                  x
 Surface Water Sampling                        x
 Groundwater Sampling                                                                |---|                                                                 |---|
 Surveying                                                  |---|
 Demobilization                                                    x
 Chemical Analysis                                               |----- ---------|        |----------------|                                                    |-------------|

GENERAL TASKS
 Management                   |--------------------------------------------------------------------------------------------------------------------------------------------------------------
 Status Report                                           x                   x                   x                   x                   x                   x                   x         x
 Informal Data Report                                                                        x                             x                                                      x
 First Draft Report                                                                                                                  x
 Briefing *
 Second Draft Report *
 Final Report *
==============================================================================================================================================================================================

* Date to be determined by TFM
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FIGURE 7.0-1. PROPOSED SCHEDULE FOR AF PLANT 85 IRP STAGE 2

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APPENDIX A

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

ADP	Automated Data Processing
AF IRP	U.S. Air Force Installation Restoration Program
ARAR	Applicable and Relevant or Appropriate Requirements
ASTM	American Society for Testing and Metals
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DCE	Dichloroethane
DEQPPM	Defense Environmental Quality Program Policy Memorandum
DOD	Department of Defense
DQO	Data Quality Objectives
EP	Extraction Procedure
EPA	Environmental Protection Agency
FONSI	Finding of No Significant Impact
FS	Feasibility Study
gpm	Gallons per minute
HNU	a photoionization detector for organic vapors
H&SP	Health and Safety Plan
IRPIMS	Installation Restoration Program Information Management System
K_{ow}	Soil Adsorption Coefficient
MeCl	Methylene Chloride
MCLs	Maximum Contaminant Levels
MCLG	Maximum Contaminant Level Goals
NAAQS	National Ambient Air Quality Standards
NCP	National Contingency Plan

ACRONYMS AND ABBREVIATIONS
(Continued)

NGVD	National Geodetic Vertical Data of 1929
NPDES	National Pollution Discharge Elimination System
OEHL	Occupational and Environmental Health Laboratory
OSHA	Occupational Safety and Health Administration
OVA	Organic Vapor Analyzer
PCB	polychlorinated biphenyls
PDWS	Primary Drinking Water Standards
PQL	Practical Quantification Limits
QAPP	Quality Assurance Project Plan
RI/FS	Remedial Investigation/Feasibility Study
SDWS	Secondary Drinking Water Standards
SMSA	Standard Metropolitan Statistical Area
TCE	Trichloroethene
TDS	Total Dissolved Solids
TSCA	Toxic Substances Control Act
USAF	United States Air Force
USGS	United States Geological Survey
WTP	Water Treatment Plant